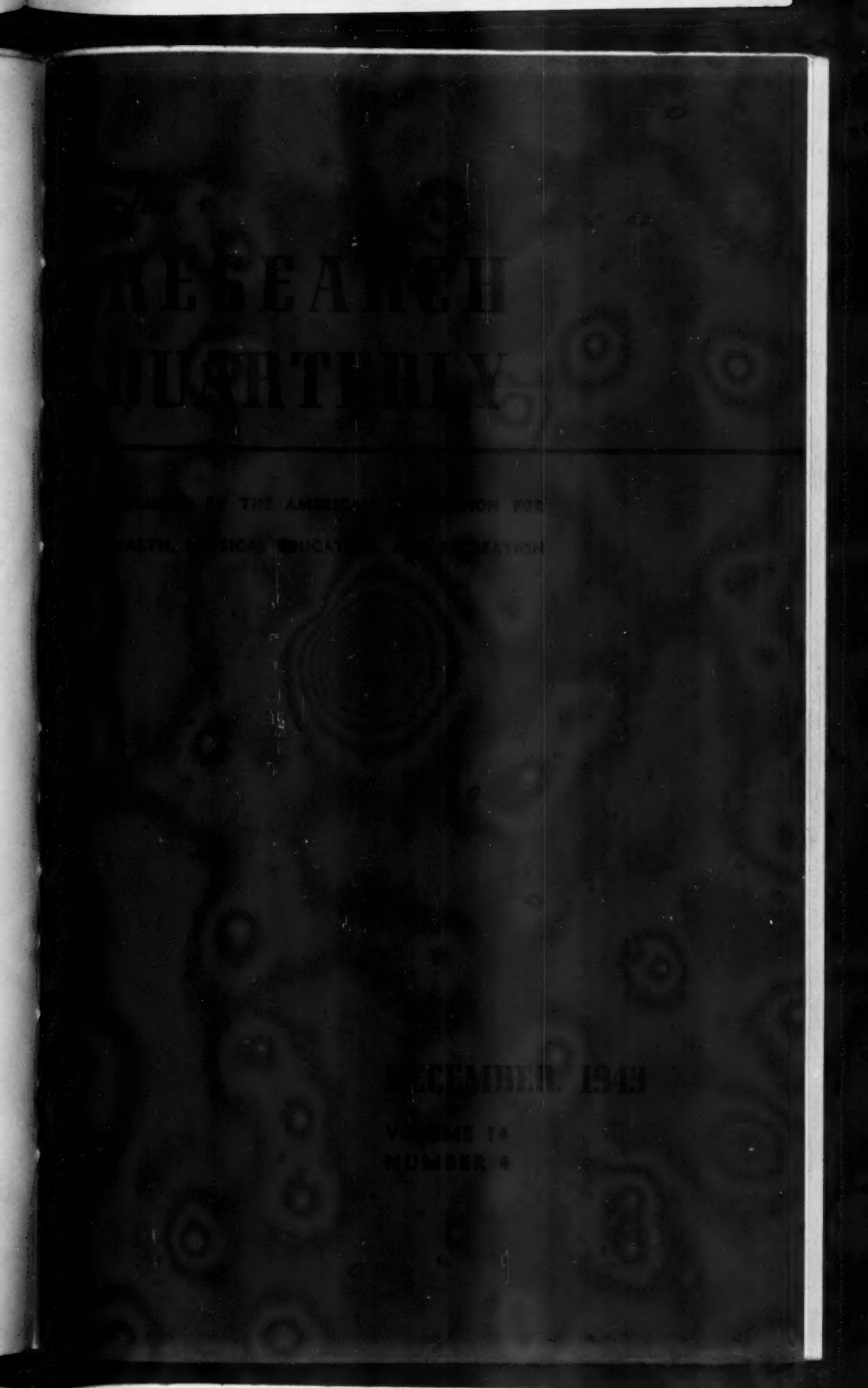

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War Emergency Teacher Certification in Physical Education in the United States

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INTRODUCTION

INTEREST in physical education is always intensified in wartime. Army and Navy, employers in industry and agriculture, educators, youth, and dispassionate observers of the social scene—all have their reasons for turning with renewed appreciation to physical education. Whatever their several reasons may be, one thing is clear. They are all assuming *good* physical education. And that means good teachers.

However, the fact of a teacher shortage in the United States is clear.[1] And, further, certain specific secondary school subjects have been particularly affected by the shortage. Opinion has been fairly uniform that physical education is one of these subjects.[2]

The teacher shortage in secondary school physical education has come concurrently with a new emphasis on intensified, vigorous activity programs, and with a wartime stress on program expansion. The United States Office of Education, with the co-operation of the Army, the Navy, the U. S. Public Health Service, as well as the American Association for Health, Physical Education, and Recreation, has played a very active role in this expansion. Through a network of institutes—regional, state, and local—stress has been laid on the importance of "physical fitness" as one phase of the physical education of every boy and girl in every high school in the United States.

The problem of how to find more and better trained teachers

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1 "Teacher Manpower Problems and the War," U. S. Office of Education (mimeo.), July 6, 1943; Carter Good, "Educational Issues of 1942 and the Task Ahead," *School and Society*, March 28, 1943, pp. 341-347; "This War and the Teacher," A Statement Prepared by the Commission on Teacher Education of the American Council on Education, *Education for Victory*, June 15, 1942, p. 2; "The Teacher Shortage—Are We Meeting It?", *Education for Victory*, Aug. 2, 1943, pp. 1-5.

2 Jackson Sharman, "Meeting the Teacher Shortage," *Journal of Health and Physical Education*, May, 1943, pp. 260-61; Society of State Directors of Physical and Health Education, Resolution No. III, April, 1943; "Meeting the Teacher Shortage in Wartime Physical Education," *Education for Victory*, September 15, 1943, pp. 17-22; Carter Good, *op. cit.*, p. 343.

for these secondary school physical education programs has arisen at a time when the educational press is full of vigorous discussion of the lowering of teacher certification standards through the issuing of war emergency certificates or permits.[3] The hazards of this practice are portrayed, and reasonable safeguards suggested. Lessons of the first World War are recalled in the effort to prevent similar difficulties this time.

Here, then, is a dilemma. Physical education programs are to be expanded and to be more vigorous. It has been claimed that there are too few well trained teachers to carry on such programs. One of the methods used to overcome this shortage is the emergency certification of teachers, an expedient which is fraught with difficulties. Physical education has much to lose if standards for teachers are changed unwisely at this critical time. It has much to gain by studying its problems, such as that of teacher certification, with a view to the future as well as to the present.

BACKGROUND OF THE PROBLEM

War emergency certification for secondary school physical education teachers cannot be best understood, except in the light of (a) changes in the extent of training required for the certification of these teachers in recent years, and (b) certain general problems of emergency certification. Let us consider these separately.

(a) There has been a steady increase in the number of states demanding graduation from a 4-year college as a prerequisite for the physical education teachers in secondary schools. As late as the first World War and well into the 1920's, it was not uncommon for a 2-year special course in physical education to be accepted as a basis for certificating these teachers. In 1931, the U. S. Office of Education published a study, "Requirements by State Departments of Education for Teachers and Supervisors of Physical Education in Grade and High Schools."[4] Similar data for 1942 have been compiled on the basis of information by Morehouse and Schaaf,[5] supplemented by data from letters received in our own study, or by the U. S. Office of Education Circulars 35[6] and 213.[7] All forty-eight

3 John W. Studebaker, "Issuing Emergency Certificates," *Education for Victory*, June 1, 1942, p. 2; Benjamin W. Frazier, "Teacher Certification in Wartime," *U. S. Office of Education Circular No. 213*, Sept., 1942, pp. 12-14; Robert C. Woellner, "Solving the Teacher Shortage," *The School Review*, March, 1943, pp. 134-8; Carter Good, *op. cit.*, p. 343; John Emens, "Report of the Sub-committee on Certification and Accrediting Agencies," *The North Central Association Quarterly*, April, 1943, pp. 383-4.

4 Marie M. Ready, "Requirements by State Departments of Education for Teachers and Supervisors of Phvsical Education in Grade and High Schools," *U. S. Office of Education Circular No. 35*, March, 1931.

5 L. E. Morehouse and O. Schaaf, "Prerequisites for Teacher Certification in Physical Education in the United States," *Research Quarterly*, 13:3 (Oct., 1942) pp. 286-298.

6 Marie M. Ready, *op. cit.*, pp. 2-8.

7 Benjamin W. Frazier, *op. cit.*, pp. 5-6.

states are accounted for in the figures for 1931 and 1942. These are shown in Table I. The change in the extent of college preparation required for certification of secondary school physical education teachers during this period is clearly seen in the table.

Table I shows the marked increase that has occurred in the amount of college or professional education required for the certification of secondary school physical education teachers between 1931 and 1942.

TABLE I

YEARS OF COLLEGE OR PROFESSIONAL EDUCATION REQUIRED FOR CERTIFICATION OF SECONDARY SCHOOL PHYSICAL EDUCATION TEACHERS, 1931 AND 1942

Minimum number of years of college or professional preparation	*No. of states* 1931	*No. of states* 1942
No special regulations for these teachers	9	1
1 year or fraction	4	0
2 years	9	4
3 years	7	2
4 years	19*	40**
Graduate of standard post-secondary course in physical education	0	1
Total	48	48

* Requirement of semester hours in physical education ranges from 6-48, except that two states do not require physical education courses.

** Requirement of semester hours in physical education ranges from 6-60, except that one state does not require physical education courses.

Forty states required 4 years of such work in 1942, as compared with 19 states in 1931. Only seven states, or possibly eight, accepted less in 1942, whereas 29 had accepted less in 1931. The members of the physical education profession will be deeply concerned that such an advance in teacher preparation in this field shall not be overlooked or lost.

(b) The trend in emergency certification of teachers in general has been indicated in a recent report of the U. S. Office of Education[8]:

No. of emergency certificates issued in	
1940-41	2,305
1941-42	4,655
1942-43 (to March)	36,689

On the assumption that such emergency certification may also be fairly prevalent in physical education (and the present study has shown this assumption to be correct), the general problems are of vital interest to the physical education profession.

Emergency certificates are granted to persons who, for various reasons, do not qualify for a standard credential. In some cases, as for example in the employment of fully qualified married women teachers, there is not necessarily any lowering of standards. In most

8 "Teacher Manpower Problems and the War," p. 4.

cases, however, there is a frank acceptance of persons who are quite without some of the qualifications a state ordinarily demands of its teaching personnel. This lowering of standards, while necessary to meet a temporary teacher shortage, can have most unfortunate results unless proper safeguards are woven into the emergency planning.

The experience of the first World War may serve to clarify the nature of the difficulty. Evenden[9] has drawn the picture very clearly. He has shown that then, as today, there was a sharp lowering of standards for the certification of teachers, and that it proved almost impossible in many cases to get rid of these people after the war. The security of a teaching position made this a highly desirable berth, in a period of widespread unemployment. Many well trained teachers, returning from the war, found their positions closed to them for this reason. This came about, says Evenden, "because no satisfactory plan had been worked out to make temporary certificates temporary."[10]

This point of view, that inadequately trained teachers constitute a serious problem in lowering the quality of education that should be assured to children and youth, and that any lowering of standards must be more surely temporary than it has been before, has widespread acceptance among educators today. Two examples will serve to illustrate the point. One of the recommendations approved at the conference of the Council on Co-operation in Teacher Education, in March, 1943, was that their member organizations should "see to it that permits granted to emergency teachers should be strictly temporary in character."[11] Again, the North Central Association in suggesting ways of meeting the teacher shortage, recommended that these special temporary certificates be issued only where absolutely necessary and then under the following conditions: "Such temporary certificates should be issued only after all qualified available candidates are employed, and then only upon specific request to the State Certification Agency by an employing official. Such certificates should be valid for the specified school only and should expire at the end of the current school year. To obtain such a special temporary certificate for another year the candidate should be required to obtain additional credits, if not fully qualified."[12]

The problem of emergency certification of teachers is further complicated by the fact that there is a marked decrease in the number of students now preparing for teaching. It is reported that during the past two years the teachers' colleges have lost one-third of

9 E. S. Evenden, *Teacher Education in a Democracy at War*, American Council on Education, 1942, pp. 32-3.

10 *Ibid.*, p. 33.

11 "An Important Conference on the Education of Teachers," *School and Society*, May 15, 1943, p. 576.

12 John R. Emens, *op. cit.*, p. 384.

their students, and that schools of education in the colleges and universities have experienced a comparable loss in enrollment.[13] A shortage of well trained teachers in the post-war period may be expected therefore, and such an anticipated shortage presents a problem which merits serious consideration. The lessons of the first World War should, indeed, make clear how important it is to see ahead, and to plan ahead now. Physical education, a young profession that has much to lose by a misunderstanding of its functions and a lowering of its standards for preparation, should be deeply concerned with the facts related to the wartime certification of teachers, as well as the lasting influence emergency measures may have on long-term planning.

THE PROBLEM

This study was undertaken to ascertain (1) how widespread, nationally, is the shortage of secondary school men and women physical education teachers, and (2) what emergency measures, particularly through the modification of certification requirements are being taken by the several states to fill such positions.

THE PROCEDURE

A letter of inquiry was sent to the 28 members of the Society of State Directors of Health, Physical Education, and Recreation, and to the Superintendent of Public Instruction in the other 20 states. The main text of the letter, dated August 14, 1943, was as follows:

The shortage of adequately prepared teachers of physical education at the secondary school level has become fairly acute in California, as it has in many other parts of the country. Problems of emergency certification confront many state directors.

Reports indicate that various measures are taken by the different states to maintain the supply of secondary school teachers. The reports to date are lacking about specific information on the measures being adopted in the assignment or certification of physical education teachers. With the wartime emphasis on highly vigorous activities, there are special problems as well as actual hazards in this field. We are, therefore, undertaking a study of this problem, and would appreciate hearing from you at least briefly regarding the situation in your state.

The immediate questions are the following:

1. Is there a shortage of adequately prepared physical education teachers in your junior or senior high schools? For boys? For girls?

2. If so, what measures have been adopted for replacing these teachers? Do you assign women teachers to the boys' program, assign teachers with a general certificate to this special field, provide in-service training for certain groups, make emergency modification of certification requirements, or make other adjustments?

3. What, if any, specific emergency certification of teachers for these positions has been made, or is contemplated?

May we know the particular changes that differentiate the preparation of the candidate, length of service, etc., from the usual requirements in normal times. It will be helpful to receive any supplementary printed or mimeographed material.

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13 "Teacher Manpower Problems and the War," p. 4.

RESULTS

The following data are based on the 41 replies received from the 48 states. Eighty-five per cent of the states responded to the letter of inquiry. As yet no replies have been received from Connecticut, Georgia, Kentucky, Louisiana, Nevada, Tennessee, and Vermont.

1. In answer to the question, "Is there a shortage of adequately prepared physical education teachers in your junior or senior high schools?", the following information was given:

Yes: 38 states (for boys, 36; for girls, 33; not specified, 2)
No: 1 state
No information available: 2 states

Many replies stated that the shortage was "acute," "decided," "critical." A few said it was "equally acute for boys and girls"; others, "more acute for boys," or "not so great for girls." Only one wrote that superintendents were finding it more difficult to secure trained women in physical education than trained men.

2. The purpose of the second question in the letter above was simply to find out in a general way which of the various measures that have been proposed for meeting the teacher shortage in secondary school physical education are being employed. The replies to this question were not complete, partly at least because of the form of the question. In a number of cases, however, the respondent stated that he did not have the information available. Specific information in the many subject matter fields is not always accessible to state departments of education in a period of emergency like the present.

A summary of the measures reported for replacing these teachers follows:

(a) *Assignment of women teachers to the boys' program:*

Yes: 21 states
No: 8 states
No reply: 9 states

The 21 states in which women teachers are assigned to the boys' program are distributed over the whole country. Every section of the country is represented in the "Ayes." The practice is so widespread among those replying that there are undoubtedly, among those not replying, still more states in which women are teaching boys' physical education. Some respondents claim many such appointments; others, a few. Two of the 21 have recommended the practice, but have no information as to whether or not such assignments have actually been made. One state reported the practice only in its junior high schools.

(b) *Assignment of teachers with a standard general certificate to physical education.*—The answer to this question was unequivocally *yes*. Almost everywhere, it appears, teachers who are not trained in physical education, but who hold a standard general certificate, and

have an interest and aptitude in the subject, are assigned to the teaching of physical educaction in high schools. In some cases they are asked to attend institutes or summer courses, although this is not ordinarily required.

(c) *Provision for in-service training:*

Yes: 18

No: 1

In-service training was described in 10 cases as physical fitness institutes or conferences; in 4 cases, as summer courses at teacher-training institutions (two of these were reported to be poorly attended); and in 2 cases, as refresher courses in the colleges. In 4 cases, the training was not described. In one state the director of physical education spends more time than formerly in the schools, giving the untrained teachers additional help.

It will be noted that some of the usual types of in-service training are not even mentioned here. It may be that they are actually missing. It may equally well be that the information is not available to state departments of education, unless they have had occasion to ask specifically for it.

One of the things that is clear in the replies is that there is a good deal of discouragement about the attempts made this past year to persuade those who wish to qualify in physical education to attend summer sessions or refresher courses. Only one state reported that local boards of education had been asked to subsidize this training, as recommended by the American Association for Health, Physical Education, and Recreation.[14]

The possibilities of in-service training for emergency teachers of physical education seem to have been largely unexplored, except through physical fitness institutes.

(d) *Emergency modification of certification requirements for teachers of physical education.*—The replies showed this practice to be almost universal throughout the United States. The findings are given in detail in section 3 below.

(e) *Other adjustments.*—The word "other" is a catch-all. There is no doubt that the items reported under this heading are to be found in a larger number of states than those mentioning them in their replies. Those listed include: recall of former teachers, issuing of bulletins or manuals, preparation and use of pupil leaders, appointment of married women teachers, selection of elementary school teachers with special aptitude, help from wives of military leaders and industrial workers. One state director wrote that superintendents handled physical fitness classes in addition to their other duties.

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14 *Proceedings*, National War Fitness Conference, AAHPER, April, 1943, p. 147.

3. The extent and the nature of wartime emergency certification of secondary school physical education teachers have been summarized from the letters and from the supplementary materials received from the 41 states co-operating in this study.

First, as to extent. In one state the state department of education does not certificate teachers. Three states report that they have not changed their certification requirements for teachers of physical education. Thirty-seven of the 41 states have modified their requirements, more or less extensively, as the data below indicate.

Second, as to nature. The pattern of emergency certification requirements in the 37 states reporting such changes is almost as varied as the number of states. It seemed advisable, therefore, to select certain pertinent questions, and to summarize the data first around one and then around another. In this way it is possible to see more clearly the significant implications.

As indicated heretofore, pressing questions relating to emergency certification have to do with the length of time during which the certificate is valid, and under what circumstances it is granted. The following analysis shows the number of states falling into similar patterns in regard to the following: length of time for which the certificate is issued, whether it is renewable, whether it is issued for a specific position only, and on whose request. In the few cases in which two types of emergency credentials are issued by any state, both are included in all the tables and discussion which follow.

A. Emergency certificate or permit granted:
   (1) Valid for 1 year; not renewable.
   (2) Issued for a specified position, on request of employing superintendent, principal, or school district official. Number of states, 4.

B. Emergency certificate or permit granted:
   (1) Valid for 1 year; renewable annually; to be issued during the period of the national emergency only. (In some cases, renewal depends on further training.)
   (2) See A (2) above. (Not stated in 1 case.) Number of states, 5.

C. Emergency certificate or permit granted:
   (1) Valid for 1 year; whether renewable, not stated.
   (2) See A (2) above. (Not stated in 2 cases.) Number of states, 8.

D. Emergency certificate or permit granted:
   (1) Expiration date fixed by State Board of Education, or by Superintendent of Public Instruction; but valid only during the emergency and 6 months, or some short period, thereafter.
   (2) See A (2) above. (Not stated in 1 case.) Number of states, 5.

E. Emergency certificate or permit granted:
   (1) Expiration date fixed by State Board of Education, or by Superintendent of Public Instruction; but valid for three years after the emergency, if employment is continuous.
   (2) See A (2) above. (Not stated.) Number of states, 1.

F. Emergency certificate or permit granted:
   (1) Not stated, or not fixed: expiration date and whether renewable.

(2) See A (2) above, for 4 cases. (Not stated in 3 cases.) Number of states, 7.

G. Emergency certification "same as for any teacher." (No further information given.) Number of states, 2.

H. Certification apparently unrestricted. No definite information given. Implication that the situation was out of hand, in statements like the following: "We allow schools to make any possible arrangement for handling their physical education work." "We are forced to use best available person and naturally are not requiring rigid regulations with regard to certification." "It is very evident that we are having to be very liberal in our certification department." Number of states, 7.

The 17 A, B, and C type certificates or permits described above are issued for one year, and together with the 5 in D are clearly intended for the "duration." Those from E through H, 17 in all, are not so clearly stated. The 14 in F and H represent the least desirable situation, and present the greatest difficulty of control after the war. These 14 states, and particularly the 7 in H, may feel the pressure of the teacher shortage more intensely than do the others. In their sheer despair, this apparently unrestricted certification may arise. Some compassing about of all emergency credentials or permits seems desirable for the long-range view, no matter what the pressure of circumstance at the moment may be.

Of the 22 states issuing the A through D type of permits, all but 4 issue these for a specified position in a given school, on the request of the proper school official—the superintendent, principal, or school district officer. These officials are required to give a statement of need, certifying that they can find no better trained person available, and in some cases describing the steps they have taken and the agencies to which they have turned for candidates. Sometimes they must state that the work cannot go on, unless the candidate is appointed.

The Alabama "Application for Emergency Provisional Certificate" is an example of permit forms in which the restrictions are set forth with some clarity:

APPLICATION FOR EMERGENCY PROVISIONAL CERTIFICATE

In making this application for a teacher's Emergency Provisional Certificate to be valid for use in the public schools of Alabama, I understand that the certificate which will be issued is valid for a period of one year only and is not subject to reinstatement or continuance on any condition.

The application for an Emergency Provisional Certificate is based on the following: (Statement is made here of the education and experience of the candidate, and is signed by himself.)

It is my desire to employ this teacher in a position which I have been unable to fill by a teacher holding a certificate granted in the regular way. You will find attached a statement explaining in detail the nature of the emergency and the efforts that I have made to fill the position with a regularly certificated teacher.

The applicant is to teach.....in.....
Subjects School

.....
County or City Superintendent

Date..... .....
County

A tenure limitation that was not often stated in the material received, is the following, from Maryland:

> These certificates shall be valid only during the Second World War and for six months thereafter and shall not entitle the holders to the tenure provided in sections 52 and 89 of Article 77 of the Annoted Code of Maryland 1939, and By-law 13 or to membership in the State Teachers' Retirement System; provided, however, that if a teacher who has tenure and is a member of the Teachers' Retirement System is transferred to a position where a War Emergency Certificate is necessary, he shall not lose tenure or membership in the Teachers' Retirement System during his service on the basis of the War Emergency Certificate.

The educational and professional qualifications of the applicant for an emergency credential for the teaching of secondary school physical education are a further matter of real concern. It was shown in the section on "Background" above that the educational qualifications for these teachers have increased markedly since 1931. What has happened during this emergency? The changes in the total number of years of college or professional education required, and the minimum amount of professional training in physical education accepted for emergency certification in physical education are summarized below.

The change in the total number of years of college preparation required for emergency certification was obtained by comparing the minimum standards reported by each of our respondents with the minimum standard for a regularly certificated secondary school teacher in their respective states in 1942. The latter information was obtained from the U. S. Office of Education Circular No. 213, *Teacher Certification in Wartime*[15] and from the *Research Quarterly*,[16] and was checked in a few cases by Woellner and Wood.[17] The results are as follows:

A. No change in number of years of preparation required	2	states
B. Reduction in the minimum number of years of college preparation required for emergency certification in physical education:		
(1) From 5 to 4 years	2	"
From 4 to 3½ years	1	"
From 4 to 3 years	5	"
From 4 to 2 years	6	"
From 4 to "as little as 10 hours of college work"	1	"
From 4 to high school graduation	2	"

15 Benjamin W. Frazier, *op. cit.*, pp. 5-6.
16 L. E. Morehouse, and O. Schaaf, *loc. cit.*
17 Robert C. Woellner, and M. A. Wood, *Requirements for Certification of Teachers and Administrators for Elementary Schools, Secondary Schools, Junior Colleges*, (mimeo.) University of Chicago Press, 1939.

(2) From 4 or 5 to minimum not stated*.....17 "
From 3 to minimum not stated*.....1 "
From 2 to minimum not stated*.....1 "
C. Reduction, if any, not stated.....5 "
(See following paragraph)

* Appointments depend on available candidates. "Any possible arrangements for handling the work," and "Use of best available person," are representative of comments regarding the preparation accepted.

Five respondents did not state the minimum number of years of college work for which an emergency credential would be granted. Each, however, indicated that a physical education teacher must qualify for a standard secondary school credential. All five states have a minimum of 4 years of college training ordinarily. Presumably, although not certainly, this holds for the emergency. The reduction in these cases may be solely in the area of professional preparation in physical education.

The figures tabulated here are rather startling. In B(1) 9 states are found with minimum college preparation reduced from four to two years or less; two of these state that they accept high school graduation as their minimum educational requirement. However, the 19 cases in B(2) in which no minimum is stated, pose a very special problem. Seventeen of these formerly required 4 or 5 years of college experience, one required three years, and one, two years. It will be recalled that state departments of education have been urged to name some standards, however minimum they may be, for emergency teaching certificates. The replies in this study indicate that many certificating officials give "individual consideration" to each application, in lieu of more explicitly defined standards.

A further question about the educational preparation of the candidate for an emergency certificate in physical education is the amount of professional training he is required to have had in the subject. Information on this point was given by the respondents as follows:

No professional training required in physical education.....28 states
Minimum physical education preparation specified.....11 "

The minimum physical education preparation specified in the 11 cases above was varied. The requirements of the several states are listed here:

"Sufficient hours" in the subject; 10 hours in the subject; 15 hours in the subject; 3 years of training toward a major (three states).

For those with 2 years of college experience: a one week's summer course in physical education; "training and experience" in the special subject; 6 semester hours of college credit in certain professional physical education courses, and 2 years' experience in group leadership.

A physical education minor (formerly a major).

Background of experience in fair range of physical activities, experience in handling groups of young people, and attendance at institute or summer session in physical education.

All but one of the 28 states that now require no college or professional preparation in physical education for an emergency teaching credential in this field did require such preparation for their regularly certified teachers in 1942.[18] This unfortunate situation, where subject matter must be taught by many persons unfamiliar with it, is particularly serious in the field of physical education because of its unique opportunities for education in its largest and deepest sense.

SUMMARY

An inquiry about the wartime emergency certification of secondary school physical education teachers in the 48 states brought a reply from 85 per cent of the states. The following information was revealed:

1. A shortage of these teachers exists in 38 of the 41 states replying, and in 2 additional states there was no information on the question available to our respondent in the State Department of Education. The shortage was more frequently described as acute for boys than for girls.

2. Most frequent ways of meeting the shortage of teachers were: assignment of women teachers to the boys' program (21 states); assignment of interested teachers with a standard general certificate to physical education (a usual practice in all states); provision of in-service training for inexperienced teachers (18 states); and emergency modification of certification requirements for teachers of physical education (see below).

3. Thirty-seven of the 41 states replying issue wartime emergency certificates or permits for these teachers, with the regular requirements for a standard certificate modified more or less extensively as indicated below.

4. Slightly more than half of the states issue a wartime certificate with stated limitations regarding: length of time for which the certificate is valid, conditions for renewal, the specific position for which it is issued, and on whose request it may be granted.

5. Slightly less than half of the states apparently issue an emergency certificate or permit in which these restrictions are not clearly made. In at least 7 cases, the certification is apparently unrestricted, so far as these factors are concerned.

6. The reduction in the minimum number of years of college preparation required in physical education ranged from one-half year to four years. In one case the reduction is one-half of a year; in 7 cases, one year; in 6 cases, two years. In one case, "ten hours of college work" is the minimum. In two cases high school graduation is accepted, and in 19 cases no minimum is stated, which may or may not mean the same thing.

[18] L. E. Morehouse and O. Schaaf, *op. cit.*; See also Table I, above.

7. Twenty-eight states issue emergency certificates for the teaching of secondary school physical education to persons who have had no professional training or courses in physical education. All but one of these states did require such preparation for their regularly certificated teachers in 1942.

8. Where minimum physical education preparation is specified, it varies from "a physical education minor" to "a background of experience in fair range of physical activities, experience in handling groups of young people, and attendance at institute or summer session in physical education."

CONCLUSION

"There is a tide in the affairs of men, which, taken at the flood, leads on to fortune." The wartime appreciation of physical education today may be just such a turning point in the affairs of our profession. Accepted and promoted on every hand, as it has never been before, physical education has an unparalleled opportunity to demonstrate the reality and the sincerity of its objectives. And with what personnel? Countless numbers of teachers, having little or no appreciation of the scope of the educational outcomes that are possible when they are understood and planned for, appointed of necessity on war emergency certificates. Well trained teachers, too, who know these things are still in our schools in large numbers—but not enough of them. Since, with the teacher shortage, there must be both kinds of teachers in order to keep the program going, two suggestions appear to be appropriate:

1. The physical education professional personnel in each state should plan how best to help the teachers who are struggling along on emergency permits. On the positive side, it would be sportsmanlike and generous, and we believe in that. On the negative side, it is sheer self-defense. People will soon forget that these are not full-fledged physical education teachers, and they will generalize about physical education from what they observe or hear of their work. We have suffered from that sort of thing before.

Assistance should be given these teachers so as to clearly define the area in which they may safely and competently work. While they are helped to become increasingly competent within defined limitations, they should not develop any false sense of security that would mislead them into a belief that they are adequately prepared for the profession of physical education.

2. Supervisors and teachers of physical education in each state should watch and take some active part in the formulation of standards for the emergency certification of teachers in their field. They must join forces with other teachers and administrators in trying so to circumscribe these credentials that inadequately trained teachers

will have no permanence in their positions after the emergency period is over, unless they qualify, as many of them may be encouraged to do, in accordance with peacetime standards. Temporary certificates should indeed be made temporary. The educational qualifications of candidates for emergency certificates should be at least reasonable. The lower standards on which these certificates are issued must not be allowed to interfere permanently with the long forward strides that have been made since the last World War in professional preparation in physical education.

Test Manual for Indiana University Motor Fitness Indices for High School and College Age Men

By Karl W. Bookwalter

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Bloomington, Indiana

HISTORY OF THE INDICES

IN AN effort to establish a simple, valid, and inexpensive test of motor fitness, the utilization of Index I [(chins plus push-ups) times vertical jump] was justified by a previous study.[1] This simplification of previously established tests had a validity coefficient of .831 ± .01 with a criterion of 20 items in that study. A validity coefficient of .859 ± .01 with a more select criterion of 12 items was obtained in a recent unpublished study from the same source.

Since the development of Index I, a new type of partner chinning (straddle chins) has been designed by the author. No equipment is needed for this form of chinning. McCloy has further suggested the substitution of standing broad jump for vertical jump. Accordingly, in the interests of greater simplification and adaptability, the following four indices have been developed and validated:

Motor Fitness Index I (chins plus push-ups) times vertical jump*

Motor Fitness Index II (chins plus push-ups) times standing broad jump

Motor Fitness Index III (straddle chins plus push-ups) times vertical jump

Motor Fitness Index IV (straddle chins plus push-ups) times standing broad jump.

The 12-item criterion against which these indices were validated involved 2 or more measures each of strength, velocity, motor ability, and endurance. The validities of the above indices with this criterion were .859 ± .01, .818 ± .01, .841 ± .01, .812 ± .01 respectively.

Since all of these coefficients are high and of reasonably approximate value, it would appear that instructors would be justified in utilizing that index which is most feasible with respect to their

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1 Karl W. Bookwalter and Carolyn W. Bookwalter, "A Measure of Motor Fitness for College Men," *Bulletin of the School of Education*, Vol. XIX, No. 2, Bureau of Cooperative Research and Field Service, School of Education, Indiana University, Bloomington, 1943, p. 26.

* All items are modified T-scored (60/100).

equipment and self-testing program. However, other things being equal, it seems obvious from this last study that Indices I and III are preferable.

THE USES OF MOTOR FITNESS INDICES

The most obvious use of these indices is (1) for the measurement of achievement of secondary school boys and college men in physical fitness programs including a wider range of activities than is included in the test itself. These indices involve measures of strength and velocity but are combined according to the power principle ($P=F\times V$). To this end achievement scales for the four indices are available,[2] for various Classification Index I groups (McCloy) and for the nine Height-Weight Class Divisions for College Men (Cozens).

(2) Gains in achievement for the body types quite logically and justly could be used as a basis for partial mark in the physical education service program.

(3) Finally, the use of these Motor Fitness Indices as the functional and primary classifier in an administrative ability grouping involving Classification Index I (McCloy) as the secondary structural classifier has been carefully established statistically. This administrative combination of strength or power measures with structural measures is in harmony with recommendations by McCloy, Brace, Rogers, and others.

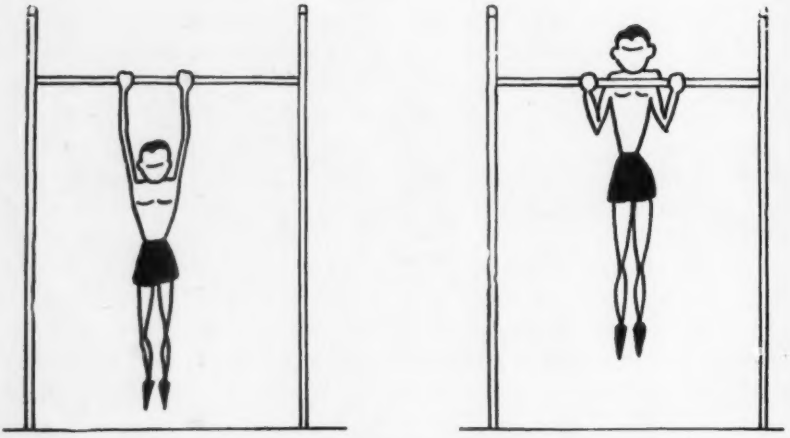
DIRECTIONS FOR ADMINISTERING THE TEST

A Motor Fitness Index can be given in one fifty-minute period to a large number of men (sixty or more). The class should be divided into groups. One half of the class should be given the chins and vertical jump (or standing broad jump) under their squad leaders. The other half should be re-divided into halves. One half of this latter group will do the push-ups while the other half records. The push-up groups will then exchange—the former recorders doing the push-ups which are recorded by the former performers. The two *halves of the class* will then exchange so that all get the chins, push-ups, and vertical jump. If the straddle chins are used, half the class can do the chins and push-ups while the other half is scored by squads on the vertical or standing broad jump. The halves are then reversed.

RULES FOR MOTOR FITNESS INDEX ITEMS

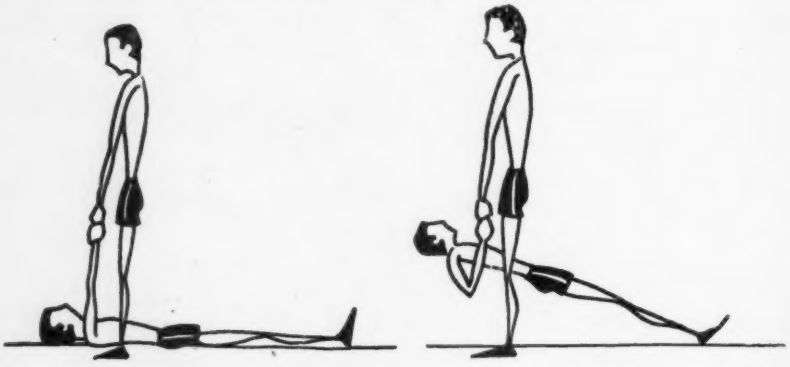
1. The chins may be performed with any grip. No half credits are permitted and the chin must clear the bar on each pull-up. Arms must be fully extended on the return. No swinging or kicking is allowed although an assistant may steady the legs of the chinner.

2 **"Further Studies of Indiana University Motor Fitness Indices,"** ***Bulletin of School of Education, Bureau of Cooperative Research,*** **for sale by Indiana University Bookstore, Bloomington, Indiana. 50c.**



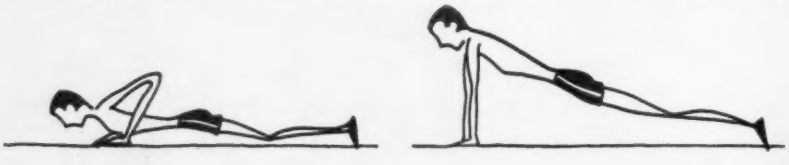
The chins must be executed regularly without rest.

2. Straddle chinning. Size the class and count off in twos. Number ones lie on their backs with arms sideward shoulder level on the floor. Upper arm is bent to vertical. Number twos stand astride and facing number ones, feet outside and touching elbows of ones.



Partners then clasp hands, bent-finger hold, and number one's chin upward as often as possible. Chest should meet firm resistance with partners' thighs each time. Both partners keep legs and back straight. Arms of supporting partner are straight throughout. Partners next change places and repeat as before.

3. The push-ups are executed from a front support. The chest must touch the floor each time and the arms must be fully straight-

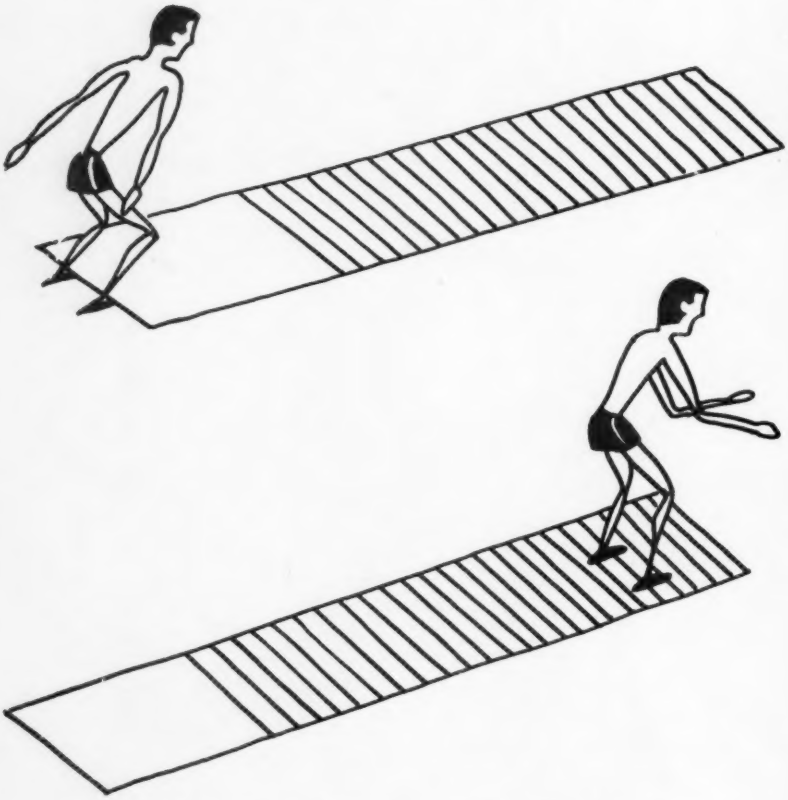


ened on the return. The back must be kept straight. No partial credits are allowed and the dips must be done regularly with no rest in between.

4. The vertical jump is made to a blackened plywood board suspended from a basketball backstop (five feet long and one foot wide). The jumper toes a line one foot in front of the board. If boards are not available, the jumper can face a wall. The index finger is chalked with magnesium. The jumper reaches as far as possible with the heels kept on the floor and makes a mark on the board with the

chalked finger. Next he executes three jumps vertically from a crouch making a mark each time upon the board. The distance from the top of the reach mark to the top of the highest jump mark is recorded as the vertical jump. Measure to the last quarter inch.

5. In the standing broad jump, the contestant toes a line which is four feet from the pit, or first 6″ mark on the mat, and springs forward off of both feet. The nearest point touched by any part of his body, at right angles to the take-off line, is his jump. Measure to the nearest inch. If jumping on the mat, lines may be marked in 6″ intervals and the nearest inches estimated.



DIRECTIONS FOR SCORING MOTOR FITNESS INDEX

The individual Motor Fitness Index Score Card, opposite page, permits of comparisons with past records and with school or present norms. Assume that the raw scores of John Doe in Motor Fitness Index I are as follows:

Chins	6 times
Push-ups	18 times
Vertical Jump	18.25 inches

Referring to the "Scale Scores For Motor Fitness Index Items," it can be seen that

6 chins earn a score of	44 points
18 push-ups earn a score of	55 points

Adding these two force items 99 points is the sum.

On the same sheet we find that a vertical jump of 18.25″ gets 35 points. By multiplying the sum of the scale scores earned on the chins and push-ups (99) by the scale score earned on the vertical jump (35) a product of 3,465 is obtained. Dividing this product by 100 (point off two places) for simplicity, and rounding to the nearest

Motor Fitness Index Score Card

Name..... Section.....

Dates of Tests								
Items	Scores							
	Raw	T-sc	Raw	T-sc	Raw	T-sc	Raw	T-sc
1. Chins, or Straddle Chins*								
2. Push-ups								
Sum of T-scores								
	To be multiplied by T-score of							
3. Vertical or Standing Br. Jump which gives the....								
Motor Fitness Index.....								
Gains in percentage.....								
M.F.I. Classification..... (E,G,F,P,I)								

*Comparisons in retests must always be of the same items (same index).

whole number, a Motor Fitness Index of 35 is obtained.

TEMPORARY NORMS FOR MOTOR FITNESS INDEX FOR COLLEGE MEN

The following norms are based upon 705 Indiana University men in the physical fitness program. The group was composed of both beginning and advanced men in about equal proportions and should be fairly representative. Norms based upon several thousands of cases and for different Classification Index or Height-Weight class divisions should be available later.

Per Cent of Total Group	*Class*	*Rating*
7	85 and up	Superior
24	59-84	Good
38	33-58	Fair (Average)
24	7-32	Poor
7	6 or less	Inferior

According to these norms the hypothetical score, figured above to be 35, is average or fair. The class intervals for these norms are based upon the mean, $\pm.5\sigma$ for fair, above $+.5\sigma$ and up to $+1.5\sigma$ as good, and all above 1.5σ as superior. Similarly, all below $-.5\sigma$ but not below -1.5σ are poor, and all below -1.5σ are inferior. Norms for these indices should be established at local high schools or colleges since many factors influence results in these tests. Among these influencing factors are (1) age, height, weight of participants, (2) time allotted to the program, (3) previous state of fitness of

participants; (4) the nature and intensity of the physical fitness program and, (5) the amount of drill devoted to the items involved in the indices themselves.

SCALE SCORES FOR MOTOR FITNESS INDEX ITEMS
(Modified T-scores $6\sigma/100$)

	Raw Scores					
Scale Score	Chins	Straddle Chins	Push-ups	Vertical Jump	Stdg. Brd. Jump	Scale Score
100	17	35	36	29.75	110	100
99				29.50		99
98				29.25	109	98
97		34	35	29.00		97
96	16				108	96
95			34	28.75		95
94		33		28.50	107	94
93						93
92		32	33	28.25	106	92
91	15			28.00		91
90			32		105	90
89		31		27.75		89
88				27.50	104	88
87			31	27.25		87
86	14	30				86
85			30	27.00	103	85
84				26.75		84
83		29			102	83
82			29	26.50		82
81	13	28		26.25	101	81
80			28			80
79				26.00	100	79
78		27		25.75		78
77			27	25.50	99	77
76						76
75	12	26	26	25.25	98	75
74				25.00		74
73		25			97	73
72			25	25.75		72
71				24.50	96	71
70	11	24	24	24.25		70
69					95	69
68				24.00		68
67		23	23	23.75	94	67
66						66
65	10	22	22	23.50	93	65
64				23.25		64
63					92	63
62		21	21	23.00		62
61				22.75	91	61
60	9		20	22.50		60
59		20			90	59
58				22.25		58
57		19	19	22.00	89	57
56						56
55			18	21.75	88	55
54	8	18		21.50		54

Raw Scores						
Scale Score	Chins	Straddle Chins	Push-ups	Vertical Jump	Stdg. Brd. Jump	Scale Score
53					87	53
52			17	21.25		52
51		17		21.00	86	51
50			16	20.75		50
49	7	16			85	49
48				20.50		48
47			15	20.25	84	47
46		15				46
45			14	20.00	83	45
44	6			19.75		44
43		14		19.50	82	43
42			13			42
41		13		19.25	81	41
40			12	19.00		40
39	5				80	39
38		12		18.75		38
37			11	18.50	79	37
36						36
35		11	10	18.25	78	35
34	4			18.00		34
33		10		17.75	77	33
32			9			32
31				17.50	76	31
30		9	8	17.25		30
29						29
28	3			17.00	75	28
27		8	7	16.75		27
26				16.50	74	26
25		7	6			25
24				16.25	73	24
23	2			16.00		23
22		6	5		72	22
21				15.75		21
20			4	15.50	71	20
19		5				19
18	1			15.25	70	18
17		4	3	15.00		17
16				14.75	69	16
15			2			15
14		3		14.50	68	14
13				14.25		13
12			1		67	12
11		2		14.00		11
10				13.75	66	10
9		1		13.50		9
8					65	8
7				13.25		7
6				13.00	64	6
5						5
4				12.75	63	4
3				12.50		3
2					62	2
1				12.25		1

HOW TO DETERMINE LOCAL NORMS FOR I.U. MOTOR FITNESS INDICES AND OTHER TESTS AND MEASURES

In outline form the following are the steps to take in setting up local norms for results in any of the motor Fitness Indices or other tests and measures employed in the physical fitness program.

1	2	3	4	5
Interval	f	d	fd	fd^2
130 - 139	4	7	28	196
120 - 129	6	6	36	216
110 - 119	9	5	45	225
100 - 109	8	4	32	128
90 - 99	21	3	63	189
80 - 89	33	2	66	132
70 - 79	46	1	46	46
				316
60 - 69	62	0		
50 - 59	68	—1	— 68	68
40 - 49	91	—2	—182	364
30 - 39	70	—3	—210	630
20 - 29	52	—4	—208	832
10 - 19	20	—5	—100	500
0 - 9	8	—6	— 48	288
				—816
	N = 498			3814

$$C = \frac{\Sigma fd}{N} = \frac{316\text{-}816}{498} = \frac{-500}{498} = -1.004$$

$$c = -1.004 \times \text{S. I.} = -1.004 \times 10 = -10.04$$

$$\text{G.A.} = \frac{69\text{-}60}{2} + 60 = 64.50$$

$$\text{A.M.} = 64.50 + c = 64.50 + .-10.04 = 54.46$$

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N} - C^2 \times \text{S.I.}} =$$

$$\sqrt{\frac{3814}{498} - (1.004)^2 \times 10} =$$

$$\sigma = 25.78$$

Letter Marks and Equivalent Scores:
A 94 and up
B 68 - 93
C 42 - 67
D 16 - 41
F or less 15

1. Subtract the lowest score from the highest score to determine the *range*.

2. Decide on a conveniently sized step interval such as will provide between 10 and 20 steps. (In the example above a step of 10 points has been chosen.) These intervals are written to the left of the sheet in ascending order as in Column 1.

3. Tally all the cases opposite their appropriate step intervals and write the frequencies (numbers of tallies in each interval) in the f column, 2.

4. Pick an interval at about the middle of column 1 and write down the deviations of other intervals, above and below this mid-interval, in the d columns under 3.

5. Find the products of the frequencies times their deviation and write them in the fd column, 4.

6. Multiply these products by their respective deviations (column 3 times column 4) and write them in the fd^2 column, 5.

Step 7 is to find the mid-point (64.50) of the mid-interval (60-69 in this case) and add the correction ($\frac{\Sigma fd}{N} \times SI$). This is the arithmetic mean (A.M.) and in this case is 54.46.

Step 8 is to determine the standard deviation $\sqrt{\frac{\Sigma fd^2}{N} - C^2 \times S.I.}$. In this case the standard deviation (σ) is 25.78.

Step 9 is to find the limits of the "C" groups 54.46 $\pm$ .5σ; the "B" groups more than .5σ above 54.46 and less than 1.5σ above the average; the "A" group all scores above 1.5σ in like manner the "D" group, below —.5σ below the average (54.46) to —1.5σ; and finally the "F" group all scores below —1.5σ.

Factors in Motor Educability

By Aileen Carpenter
University of Texas
Austin, Texas

In 1932 Johnson presented a test for sectioning classes into homogeneous units.[3] * Later work showed that his test was primarily one of motor educability, the speed with which new motor skills are learned.[5] One of the outstanding virtues of the Johnson type of test is that while the skills involved are basic to a variety of motor performances, they are for the most part not skills which students have learned as such in previous work. This type of test is given individually so takes longer to administer than does the stunt type, but it is probably more accurate in the information which it provides about the student.

In still further studies, Barton and Roads[1,7] included the original ten of the Johnson tests and a number of Johnson type tests patterned after the originals and using the same mat. They found several of these to be highly useful.

In the present study, a part of a larger study of motor ability and motor educability, the ten original Johnson tests were used together with the eight Johnson type tests which Barton and Roads

TABLE I

Mean Scores of Individual Johnson Type Tests, Correlations of Each with Sum of Original Ten and with Sum of Eighteen, Means of Test Scores

Test #	r with 10 Johnson	r with 18 Johnson	Mean
1	.3644	.3161	9.09
2	.3557	.3572	9.24
3	.4695	.4644	8.14
4	.5948	.5493	7.11
5	.6276	.5415	8.60
6	.5683	.4892	6.63
7	.6554	.6055	6.21
8	.6111	.5873	7.15
9	.6656	.6261	7.20
10	.4869	.4630	1.29
11	.2691	.3709	7.93
12	.2976	.4421	8.92
13	.2013	.3187	8.73
14	.3185	.4909	8.45
15	.3661	.4717	7.14
16	.3255	.4378	6.84
17	.2932	.5124	3.99
18	.4795	.6310	7.97

10 Johnson—18 Johnson .9096

* Superior figures refer to numbered bibliography at end of article.

found to be of greatest value. Complete records were secured for 128 high school girls, freshmen and sophomores for the most part. Johnson directions were followed throughout. The individual test results were then correlated with the total score for all eighteen and with the total score for the original ten. Table I gives these correlations together with the means for each of the tests.

Those tests which showed low correlations with the two criteria (numbers 1, 2, 11, 12, 13, 16) as well as those whose means were so high that obviously the tests are too easy for high school level (numbers 1, 2, 11, 12, 13) were eliminated from further study. The remaining twelve tests, their total, the Strength Index,[5] and Physical Fitness Index[5] for each of the girls were intercorrelated and put into a Factor Analysis[6,8] which after rotation gave the results shown in Table II. The significance of results such as these obtained from a factor analysis is that one can pick out the specifically different things, that are measured by the tests. In the process of factor analysis, tests group themselves. The ones testing a specific thing form a group showing that they measure this specific thing, or "factor," to a certain degree. The "factor loading" of each test is* the correlation of the test with that factor.

TABLE II

ROTATED FACTOR LOADINGS
JOHNSON TYPE TESTS

	I	II	III	IV
1. Strength Index	.8263	—.0430	.0045	.0414
2. P. F. I.	.7428	.0756	.0028	—.0195
3. J. 3	—.0520	.2327	.4901	.1565
4. J. 4	.2450	.1097	.5557	.0905
5. J. 5	.1908	.6899	.1304	.0207
6. J. 6	.2415	.2850	.4577	—.1978
7. J. 7	.4113	.6042	.0492	—.1347
8. J. 8	.0918	.2290	.6434	—.1674
9. J. 9	.3212	.7597	—.0888	.0471
10. J. 10	.3622	.1532	.3546	—.1295
11. J. 14	.1252	.3019	.3112	.4755
12. J. 15	.1536	.1363	.4656	.0785
13. J. 17	.2213	.1861	.3335	.0590
14. J. 18	.1914	.4152	.3108	.5058
15. 12 J's	.3159	.7044	.6352	.0881

Factor I is unquestionably strength which apparently is not a very important component of the other variables and will not be considered further in this study.

Factor II includes only those tests which consist of forward and backward rolls so this factor must represent a phase of body

* Those unfamiliar with the significance of the Factor Analysis will find a fairly uncomplicated explanation of it in McCloy's article entitled: "The Factor Analysis as a Research Technique," *Research Quarterly*. 12:1 (March 1941).

control in turns about a lateral axis, probably closely related to the functioning of the semi-circular canals.

Factor III seems to be more general in nature and is probably the ability to solve new motor skill coordination problems quickly —or true motor educability.

Factor IV is represented by the two tests in which the trunk is horizontal and the orientation of the head is different from the usual ones and the arms are used as organs of locomotion. We have no name assigned to this possible complex factor. It could be another orientation factor or it could be simply the ability to master pronograde locomotion—or even a measure of the locomotive strength of the arms. The multiple correlation is too low to justify using this factor for predictive purposes.

Multiple correlations were computed in order to determine which of the tests showing fairly high loadings in the various factors were essential for the prediction of those factors. The multiple correlations are given in Table III. Test 18 is not of great importance in Factor II so it was dropped from II but since it is essential in Factor IV it was retained in the total nine tests which are recommended. Test 6 is apparently not of too much importance in Factor III so it was dropped. Directions for each of the nine tests may be found at the end of the article.

TABLE III

MULTIPLE CORRELATIONS OF JOHNSON TYPE TESTS WITH FACTORS

O = Factor II		O = Factor III		O = Factor IV	
R O. 9, 5, 7, 18	.8225	R O. 8, 4, 3, 15, 6	.7905	R O. 18, 14	.5573
R O. 9, 5, 7	.8169	R O. 8, 4, 3, 15	.7805		
R O. 9, 5	.8078	R O. 8, 4, 3	.7580		
R O. 9, 7	.7723	R O. 8, 4	.7723		

Possibly the scores for the individual tests should be weighted in order to more accurately determine the individual's score for any one factor. From regression equations, formulae were computed for the weighting of the various test scores included in each factor. The formulae were simplified by division of the whole by the weighting for one, as is indicated. The weighted factor scores were then computed for each individual. The weighted and unweighted scores were then correlated. The correlations, given in Table IV, are all so high, well above .9, that it can safely be concluded that weighting is unnecessary, that the sums of the raw scores give sufficiently accurate estimates of the individual's ability in each factor. Formulae both original and simplified and the resulting correlations are given in Table IV.

This study would seem to indicate that there are at least three factors in the total picture of educability as portrayed by this type of test. The nine tests recommended can be used in several differ-

TABLE IV

WEIGHTING FOR THE THREE FACTORS, CORRELATIONS OF THESE FACTORS WEIGHTED AND UNWEIGHTED

Factor II = 1.6180 J 9 + 1.3844 J 5 + .5100 J 7 (original)
= 3.1725 J 9 + 2.7145 J 5 + 1 J 7 (simplified)
Factor III = 1.7652 J 8 + .9750 J 4 + 1.4451 J 3 + .9660 J 15 (original)
= 1.8273 J 8 + 1.0093 J 4 + 1.4959 J 3 + J 15 (simplified)
Factor IV = 1.2931 J 18 + .9285 J 14 (original)
= 1.3927 J 18 + 1. J 14 (simplified)

r	Factor II (raw)	—	II (weighted)	.9371
r	Factor III (raw)	—	III (weighted)	.9432
r	Factor IV (raw)	—	IV (weighted)	.9894

ent ways. Their sum gives an indication of the all-round educability of the girl. If, however, the investigator wants more specific information, the sums of the tests making up each factor can be used for more specific studies Factor II, where body control in turns is being studied, Factor III, in studies involving new motor skill coordination, Factor IV, while the r is not high enough to tell much, might be included where arms are used as organs of locomotion. Since T-scores are generally easier to interpret than raw scores, Tables V-VIII are included giving T-score values for the three Factors as well as for the sum of the nine tests included.

TABLE V

FACTOR II T-SCORE

(SUMS OF TESTS 5, 7, 8, 18 = FACTOR II)

Score	0	1	2	3	4	5	6	7	8	9
30	61	63	65	66	67	69	70	72	73	75
20	47	48	50	51	53	55	56	57	59	60
10	33	34	35	37	38	40	41	43	44	45
0						25	27	28	30	31

TABLE VI

FACTOR III T-SCORE

(TESTS 3, 4, 6, 8, 15 ARE INCLUDED IN FACTOR III)

Score	0	1	2	3	4	5	6	7	8	9
40	67	69	71	72	74	76	77	79	81	82
30	51	52	54	56	57	59	61	62	64	66
20	34	36	37	39	41	42	44	46	47	49
10	17	19	21	22	24	26	27	29	31	32

TABLE VII

FACTOR IV T-SCORE

(TESTS 14 AND 18 ARE INCLUDED IN FACTOR IV)

Score	0	1	2	3	4	5	6	7	8	9
20	56	58	60	62	63	65	67	69	71	75
10	36	38	40	42	44	46	48	49	52	54
0						26	28	30	32	34

TABLE VIII

E 9 JOHNSON T-SCORE

(TESTS INCLUDED ARE: 3, 4, 5, 6, 7, 8, 9, 14, 15, 18)

Score	0	1	2	3	4	5	6	7	8	9
90	66	67	67	68	69	70	70	71	72	73
80	59	59	60	61	62	62	63	64	65	65
70	51	52	53	54	54	55	56	56	57	58
60	44	45	46	46	47	48	49	49	50	51
50	37	38	38	39	40	41	41	42	42	43
40	30	30	31	32	32	33	34	35	35	36
30	22	23	24	24	25	26	27	27	28	29

DIRECTIONS FOR THE TESTS RECOMMENDED

3. Straddle Jump.

Hands on hips. Feet together throughout the exercise. Start with feet together in front of right lane. Jump obliquely with both feet to the first black square on right, then to second white square on left, finishing on finish target.

4. Forward skip, holding opposite foot behind.

Start with feet together before either right or left lane, hop with right foot into first white space, raising left foot behind and taking it with right hand behind right thigh at the same time. Hop in this position on the right foot to the first black space. Release left foot and leap with left to second white space, lifting right foot behind and taking it with left hand behind left thigh. Hop in this position on left foot to second black space. Continue this across the mat.

5. Forward Roll.

Disregard all black markings and perform in the red lane. Start outside of chart in front of center line. Perform two front rolls, the first within the limits of the first half of the lane, the second within the limits of the second half, never touching or overreaching the red lanes.

6. Jumping half turns, right or left.

Start with feet together on the first target, hands free. Jump, feet together, to second target while executing a half turn right or left, ending on second target, executing another half turn, rotating in the same direction as a barrel would be rolled along upright, ending on third target facing the finish. Continue across the mat, ending on the finish target facing starting end.

7. Back Roll.

Perform in red lane. Start in front of red lane with back to pattern. Execute two back rolls, one on each half of the lane.

8. Jumping half turns, right and left alternating.

Start as in 6, on first target. Jump with both feet, as in 6, to second target, executing a half turn either right or left. Jump, as in 6, to third target, executing a half turn in the opposite direction. Continue across the mat, alternating the direction of rotation, finishing as in 6.

9. Front and back roll combination.

Perform in the red lane. Start as in 5, facing red lane. Perform a front roll in the first half of the lane, finishing with legs crossed at ankles and executing a two-foot pivot, turning either right or left. Perform a back roll in second half of the lane.

14. Barton Roads XV.

Stand with both feet on first target. Place both hands on second target and jump, landing with feet on target between hands; proceed thus down the mat finishing on the end target.

Scoring: Deduct two points for hands not on target or feet not on target. One point for breaking rhythm.

15. B-R XVIII.

Hands on hips. Start on both feet in front of right lane with right side toward the mat. Jump obliquely forward right to first white square in left lane; jump obliquely back right to first black square in right lane and continue thus down the mat using white squares on the left lane and black squares on the right lane, finishing in last black square in right lane.

Scoring: Deduct one point for hands off hips, breaking rhythm, over-stepping.

18. B-R XXII.

Start with both feet in front of center lane. Place both hands on first target and jump with right foot in first black square in right lane and left foot on first black square in the left lane. Place hands on second target, etc. Finish with feet in last black squares.

Scoring: Deduct one point for over-stepping, breaking rhythm, missing target.

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Validity of Football Achievement Tests as Measures of Motor Learning and as a Partial Basis for the Selection of Players

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THIS study was undertaken as a part of a project in the investigation of the learning of gross bodily motor skills. It deals with measures of achievement or learning fundamental skills involved in college football. The subjects used were some 65 varsity football candidates at the University of Texas who were invited to come out for spring training in the spring of 1940. The tests selected comprised in part, tests which had been used by the writer for experimental purposes over a period of years at the University, and, in part, new tests which were devised as possible improvements over others previously used. The tests were given by Mr. Wallace Lawson, assisted by the writer.

The problem involved a study of the validity of tests of learning or achievement of fundamental skills in football as measures of real playing ability. The practical value of this research lies in the use that might be made of such achievement tests in pre-selecting those players most likely to succeed and most worthy of meriting the continued attention of coaches.

Validity of the tests used, that is, proof of whether or not the tests can be used to measure real football ability, was studied statistically and practically.

Briefly the tests of achievement may be described as follows:

1. *Forward pass at a target.*—The target consisted of a canvas sheet hung from the cross bar between the goal posts, on which concentric circles of 2, 4, and 6 feet in diameter had been outlined in 2-inch-wide painted lines. The circles were centered 7 feet above the ground. The player stood at a point 15 yards away and opposite the target, took 3 steps to the right and passed at the target. Balls hitting the center circle counted 3 points, hitting within the second circle 2 points and within the outer circle, 1 point.

2. *Fifty-yard dash carrying a football.*—The dash was timed with a stop watch.

Throughout the study, complete cooperation and assistance was given by head coach Mr. D. X. Bible and his assistants. As the writer travelled with the team he was able to have many opportunities for discussion with the coaches. The study would not have been possible without Mr. Bible's kindly and intelligent aid.

3. *Forward passing for distance.*—The test consisted of throwing a forward pass as far as possible, and was measured in yards.

4. *Pull out.*—The subject took a position on the end line midway between the goal posts, stepped back and charged around the left-hand goal post and across a line 5 yards away. The score was the number of seconds required from start to finish, measured from first movement of either foot to crossing the finish line.

5. *Blocking.*—This consisted of the time required to start from a line and block out three blocking dummies arranged at certain points and finish across another line. The dummies were arranged so that the first dummy was placed 5 yards from the starting line, the second dummy 5 yards from the first dummy and at right angles to the left, the third dummy placed 5 yards from the second dummy but back to the right at an angle of 45° from a line through the second dummy, with the finish line 3 yards from the third dummy and parallel to the starting line.

6. *Punting.*—The test was punting for distance and was measured in yards.

7. *Dodge and run.*—The Cozens' dodge and run test* was used except that a football was carried. Markers were so placed as to make the runner complete a complicated zig-zag run. The score was the time required.

8. *Charging.*—This test consisted of measuring the power with which a player could drive with the legs. The player placed one foot against the goal post and charged. A back and leg dynamometer was attached by a harness to the shoulders and then fastened to the goal post. The score was the number of pounds registered.

Data were also obtained about the following:

1. Number of quarters played previously.
2. Number of letters earned in high school.
3. Number of games played in high school.
4. Players' average ratings of the playing ability of each other.
5. The average of the three coaches' ratings of the playing ability of each player.

Scores on the eight achievement tests were converted into scale scores using the T-scale technique, thus making it possible to add the scores and obtain a single number, the total T-scale score, representing the players' total scores on the achievement tests.

RESULTS

The relationships existing between the various achievement tests are shown by the product-moment correlations given in Table I. It will be seen that in general the tests do not correlate closely with each other; in other words, they measure unrelated traits. The

* John F. Bovard, and F. W. Cozens, *Tests and Measurements in Physical Education*, (Philadelphia: W. B. Saunders Co., 1930) p. 274.

highest correlation was found to exist between the "pass at a target" and the "punt for distance" (.48), and between the "dash" and the "dodge and run" (.50). However, none of the coefficients are sufficiently high to have predictive value as to inter-relationships.

The coefficients of correlation between the total T-scores on all achievement tests and each separate achievement test are shown in Table II.

TABLE I
INTERCORRELATIONS BETWEEN FOOTBALL ACHIEVEMENT TESTS

	Pass Target	Dash	Pull Out	Pass (Dist.)	Block	Punt (Dist)	Dodge Run	Charge
Pass		.19 ± .96	.093 ± .10	.04 ± .10	.05 ± .10	.48 ± .77	.30 ± .95	.02 ± .10
Dash			.37 ± .88	.17 ± .10	.25 ± .97	.38 ± .87	.50 ± .76	.03 ± .11
Pull Out				.04 ± .10	.40 ± .87	.02 ± .10	.15 ± .11	.05 ± .10
Pass (Dist.)					.12 ± .10	.36 ± .30	.11 ± .10	.02 ± .10
Block						.15 ± .10	.16 ± .10	.33 ± .91
Punt							.42 ± .27	.08 ± .10
Dodge Run								.11 ± .10
Charge								

TABLE II
CORRELATIONS BETWEEN TOTAL T-SCORES ON ALL TESTS AND T-SCORES ON EACH SEPARATE ACHIEVEMENT TEST

Test	*Coefficient or Correlation*	*S.D.*
Pass at a target	.44	± .83
50-yd. Dash	.79	± .39
Pull Out	.60	± .66
Distance Pass	.60	± .66
Blocking	.48	± .78
Punting	.66	± .58
Dodge and run	.69	± .54
Charging	.29	± .92

Scores on the 50-yard dash were found to correlate most closely with total scores on all tests, although four other tests showed substantial correlations. These data appear to substantiate the finding that the separate achievement tests measure separate abilities.

One measure of the validity of this battery of achievement tests was the relationship existing between the total scores on the tests and the average of coaches' ratings of players' abilities. In doing this the ratings of coaches, which were made on a scale of 20, are taken as a criterion of real playing ability. The ratings given by the coaches were made at the end of spring training. The correlation was found to be .33 ± .96. Similarly the correlation between the total scores on the achievement tests and the average ratings

of playing ability given by players on each other was found to be .48 ± .82. These coefficients are not high, but they do show more relationship than might appear for the reason that other studies* have shown that correlations involving judgment ratings do not run as high as would be expected with other sorts of data. The size of these coefficients would warrant the statement that they do indicate marked** relationship exists between the achievement scores and judgment ratings by coaches and players of the abilities of players. It is interesting to note that players' judgments showed closer relationship to achievement scores than did coaches' ratings. There was, however, a substantial relationship between coaches' ratings and players' ratings as shown by a correlation of .69.

Achievement scores, when correlated with the number of quarters played, produced a coefficient of .30 ± .97. Quarters played divided by years played was used as a possible measure of playing ability on the assumption that the better players would play more quarters in a given number of years than poorer players. The figure obtained by dividing quarters played by years when correlated with total achievement scores produced a coefficient of .44. This same index correlated .14 with players' ratings of each other, and .35 with coaches' ratings of players' ability. The higher coefficient between the index and coaches' ratings than between the index and players' judgments may indicate that a knowledge of previous experience may have influenced coaches' ratings.

One other index figure was developed as a possible measure of players' ability. This was 100 x quarters played divided by letters earned x average number of games played. This index correlated .12 ± .10 with coaches' ratings, and .11 ± .11 with players' ratings. These coefficients have no significance and the index used appears to have no value.

A practical measure of the validity of the football achievement tests as measures of football ability was used. This consisted of selecting the 24 players making the highest total achievement scores and comparing this list of players with a list of the first and second teams totaling 24 players as selected by the head coach and his assistants at the end of the football season. The writer felt that at least 20 players selected on the basis of their achievement scores in spring training would be found among the best 24 players as selected by the head coach the following fall.

When this comparison was made it was found that 14 players selected on the basis of their achievement scores were on the first

* D. K. Brace, *Measuring Motor Ability* (New York: A. S. Barnes & Co., 1927) pp. 20-21.

** H. O. Rugg, *Statistical Methods Applied to Education* (New York: Houghton-Mifflin Co., 1917) p. 256.

and second teams. It was also found that 6 of the players on the first and second teams had either not been out for spring training and hence had not been tested, or had been injured at the time the tests were given and were not tested. Thus, including all players whether tested or not, the number of players selected by the tests comprised 58.3 per cent of the first and second team.

Eliminating the 6 players making the first and second teams in the fall who were not tested, it was found that 77.7 per cent of those remaining were selected on the basis of their achievement scores made in the preceding spring. Only four cases, or 16.6 per cent, were selected by coaches but not by tests. This indicates that the achievement tests did have high practical validity, in other words did measure football ability when such ability was measured by making the first "string."

SUMMARY

1. Tests of the amount of learning, i.e., achievement which university football players had made in certain skills involved in football were constructed. These tests revealed marked individual differences. The abilities measured by the tests were found to have low intercorrelation with each other.

2. Total scores on the tests correlated substantially with each achievement test except in the case of "charging" (.29) and "passing at a target" (.44).

3. The best single test was found to be the 50-yard dash, in terms of total achievement scores.

4. Substantial relationship existed between achievement scores and players' opinions of the playing ability of each other, and fair correlation existed between achievement scores and coaches' ratings.

5. There was substantial relationship between players' ratings and coaches' ratings ($r = .69$).

6. The relationship between the number of previous quarters played and achievement scores was low.

7. The relationship between quarters played divided by years played and achievement scores was marked.

8. Coaches' ratings appeared to be more influenced by a knowledge of players' previous experience than were players' ratings.

9. In a practical test of validity, 77.7 per cent of those 18 players finally making the first and second teams and who had been given the achievement tests were found to be in the 24 players making the highest achievement scores.

10. Only 4 players, or 16.6 per cent, of the first 24 players selected by coaches were not included in the list of the 24 players making the highest achievement scores on football skills.

11. Interpretation of the results of this study should be in the light of the significant fact that the tests were given during spring

training six months before the football season involved, and that the selections of coaches were made toward the end of the season.

12. Although further statistical treatment of the data would be profitable, the results obtained indicate to the writer that a battery of achievement tests could very profitably be used in measuring the amount of learning, i.e., general ability, in football skills possessed by players. This would be of real assistance to coaches in selecting players, particularly where coaches have little previous knowledge of players' abilities.

Military Athletics at the University of Illinois

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In February, 1943, a course in Military Athletics was introduced as a part of the physical education curriculum at the University of Illinois. The purpose of this course was to provide conditioning activities of a vigorous nature which would better fit university students for service in the armed forces.

The University of Illinois physical education curriculum for civilian men is set up in four divisions: (1) Adapted Sports, (2) Basic Physical Fitness, (3) Limited Choice, and (4) Free Choice. It has been felt that by using these four categories is was possible to meet the needs of individual students. A comprehensive medical examination by the University Health Service followed by the Illinois Motor Fitness Screen Test is the basis for classifying students.

The Motor Fitness Test is given only to students whose medical record indicates that it is advisable. The test is used to determine the degree of fitness of each student and to classify students for activities on the basis of their test scores. The test includes fourteen items and is built around the following components of motor fitness: endurance, power, strength, agility, flexibility, and balance. These components have been selected and the fourteen items chosen following intensive research in the motor fitness field at the University of Illinois.[1] Two test items are used to measure each of these components with the exception of endurance and agility which are measured by three items. The test items and the components measured follow:

1. Endurance—leg lifts and sit-ups, chinning, mile run.
2. Power—medicine-ball put, standing broad jump.
3. Strength—man-lift and let-down, extension press up.
4. Agility—agility run, skin the cat, bar vault.
5. Flexibility—trunk extension, trunk flexion.
6. Balance—foot and toe balance, squat stand.

The Adapted Sports group includes all students whose medical records indicate that special treatment or modification of physical activity is desirable. Individual physical education programs are planned for this group on the recommendation of the Health Service.

The Basic Physical Fitness group includes all students who pass less than eleven items of the Motor Fitness Test. During the past

1 T. K. Cureton. *Physical Fitness Workbook* (Champaign, Ill.: Stipes Publishing Co., 1942).

year, approximately thirty per cent of the men students were enrolled in Basic Physical Fitness classes. This program consists of gradual increases of activity and stresses individual testing and guidance. Specific emphasis is placed upon physical fitness, requirements for improvement, all-out effort on specific exercises, general conditioning, and activities designed to build coordination.

The Limited Choice group is composed of students who pass eleven or twelve items of the test, and those who are non-swimmers. Non-swimmers are scheduled in swimming classes as facilities permit. Courses of the more vigorous type, such as, boxing, wrestling, weight lifting, and tumbling are prescribed for students in this group on the basis of test items passed and physical needs.

The Free Choice group includes students who pass thirteen or fourteen of the Motor Fitness Test items, including all endurance tests. Instructional courses available for this group are tennis, handball, ice skating, and others of a similar nature, or students may elect to take any other activity course which is offered.

The needs of students who are not physically sound or who show marked deficiencies in the established components of physical fitness are met through Adapted Sports and Basic Physical Fitness classes. Other courses in sports are provided for students who pass the health examination and who satisfactorily qualify for these courses by passing a sufficient number of Motor Fitness Test items. Because large numbers of students were preparing for immediate induction into the armed forces or were affiliated with Army, Navy, or Maine reserve units, a Military Athletics program was added to the curriculum in physical education to provide vigorous conditioning activities for these students. The course was planned specifically to meet the needs of students who were already in "comparatively good physical condition"; therefore, only students who passed the Motor Fitness Test and were eligible for Limited Choice or Free Choice courses were allowed to enroll in Military Athletics.

MILITARY ATHLETICS OBJECTIVES AND STANDARDS

The primary conduct objectives established for the course were:

1. Performing conditioning exercises according to social and hygienic standards.
2. Performing self-testing events on an all-out basis.
3. Performing individual athletic activities of a military nature according to wartime service demands.

Particular activities taught in the course were:

1. Conditioning exercises: grass exercises, bulldozer exercises, guerilla exercises, field exercises, medicine-ball exercises, rope skipping exercises.
2. Self-testing: sit-ups, push-ups, leg lifts.
3. Military Athletic activities: Jumping—running broad jump,

running pole jump; climbing—rope, wall; throwing—tossing the caber, putting the shot; running—man carrying, cross country (3 miles), obstacle course (½ mile).

Three other conduct objectives were also given consideration in the course. These were:

1. Appreciating conditioning exercises.
2. Appreciating military athletics.
3. Appreciating the value of physical fitness.

The first and second of the above objectives were attained by having the students participate in discussions, demonstrations, and supervised practice in class. The third was met by having the students prepare a term report. This report consisted of a review (1,000 to 2,500 words) of some of the more recent books on physical fitness.

The standards of achievement in each of the activities were:

1. Performance test in each of the six types of conditioning exercises: grass, bulldozer, guerrilla, field, medicine ball, and rope skipping. Two points toward the final grade were given for each test.

2. All-out trials on the three self-testing items at frequent intervals. Effort and improvement were considered in computing the final grade. These self-testing item scores were posted and continuous records were kept throughout the semester to provide motivation for individual effort in conditioning. One to five points toward final grade were given, based on class rank, improvement, and effort.

3. Performance tests in each of the nine athletic activities were given throughout the semester. Points toward final grades were given for each, based on the following scales of performance.

TABLE I

POINT SCORE SCALE FOR MILITARY ATHLETIC EVENTS

Event	*Unit*	*Grade Points*				
		1	2	3	4	5
Broad Jump	Feet	14	15	16	17	18
Pole Jump	Feet	16	18	20	22	24
Caber Toss	Feet	16	18	20	22	24
Shot-Put	Feet	24	27	30	33	36
Rope Climb	Seconds	12	11	10	9	8
Wall Climb	Seconds	12	11	10	9	8
200-Yard Man Carry	Seconds	65	60	55	50	45

TABLE II

POINT SCORE SCALE FOR CROSS COUNTRY AND OBSTACLE RUNNING

Grade Points	*3-Mile Cross Country Time*	*Obstacle Course Run Time*
1	30 min.	8 min.
2	29 40 sec.	7 50 sec.
3	29 20	7 40
4	29	7 30
5	28 40	7 20

6	28	20	7	10
7	28		7	
8	27	40	6	50
9	27	20	6	40
10	27		6	30
11	26	40	6	20
12	26	20	6	10
13	26		6	
14	25	40	5	50
15	25	20	5	40
16	25		5	30
17	24	40	5	20
18	24	20	5	10
19	24		5	
20	23	40	4	50

The first trial for each student in the events was recorded by the instructor and subsequent trials and improvements were posted for students to check their records. A final all-out performance in each item given at the end of the course determined the point allotment for each student.

The above standards were determined by consultation with track coaches and physical education staff members and the concensus of these men was used to establish point values and performances desired. Plans were made to evaluate student performance and develop norms for future courses.

The course had the advantage of being a cooperative enterprise. Frequent staff meetings and discussions were held by the instructors working with the course to study methods of improvement. Much experimentation and many modifications of procedures grew out of these meetings.

TEACHING PROCEDURE

Outlines of teaching procedure were prepared for each instructor and lesson outlines and supplementary exercise material were made available in order that continuity and some degree of uniformity would exist in all sections. A total of 1,006 students were enrolled in twenty-three sections meeting three periods weekly for one hour and the material was outlined on this basis. The outline which was used included:

I. First Week:

A. *First Day.*—Class groups were organized.

B. *Second Day.*—Instruction was given in field exercises. Field exercises were calisthenic or developmental activities which were alternated with activities requiring movement from place to place. The activities provided opportunity for vigorous exercise and for practice in movements which simulated war conditions. The exercises were of the type presented in *Physical Conditioning* by Stafford and Duncan.[2]

[2] G. T. Stafford, and R. O. Duncan, *Physical Conditioning* (New York: A. S. Barnes and Company, 1942) 110.

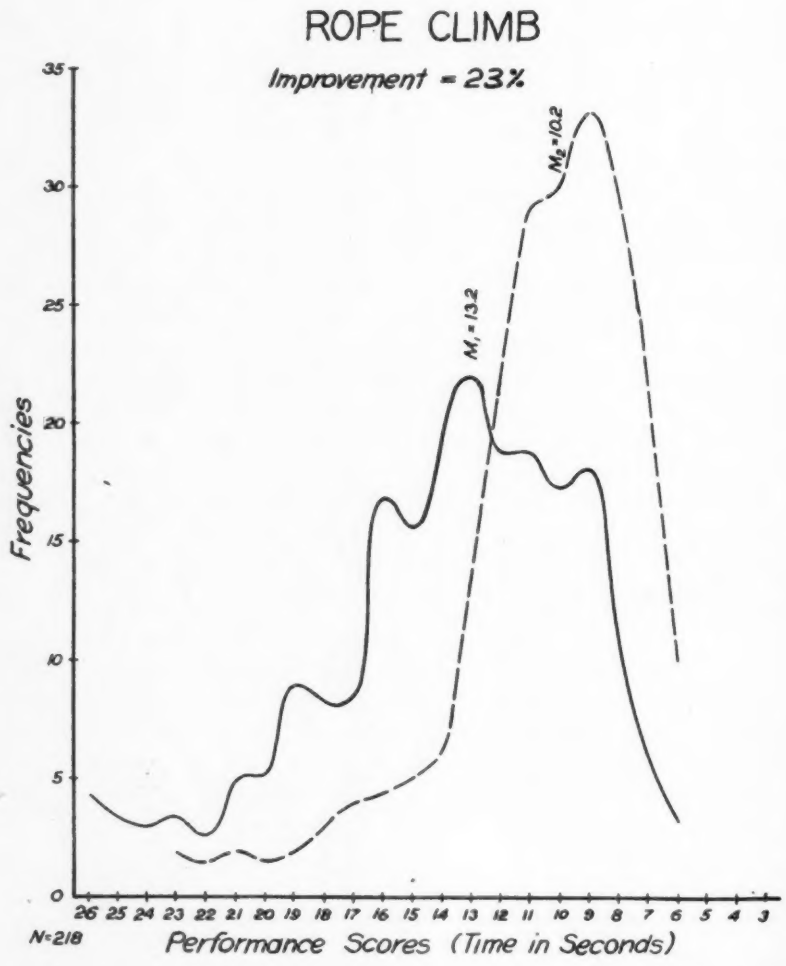

FIGURE 1. Improvement Curves for Rope Climb, Military Athletics, 2nd semester. First Test, solid line; final test, broken line.

For instruction in field exercises the group was assembled in a spread or open-order formation. The aim was to get continuous activity with very little time between exercises. Fifteen to twenty-five minutes of field exercise were conducted in a single day's class.

C. *Third Day.*—Instruction given in guerilla exercises. This type of exercise was first used from 1904 to 1912 as a part of the French physical training program. During World War I similar activities were used to train soldiers to travel in bending, stooping, and crawling positions and were called "Trench Exercises."[3]

The present conditioning drills used at the University of Illinois have been termed guerrilla exercises and have been selected and modified from *Conditioning Gymnastics* by Staley. Three types of exercises were used: ground, squat bend, and erect. All were performed while the individuals were walking in a single-circle formation at a slow pace. The instructor in the center of the circle named an exercise, demonstrated it, and then commanded the group to start. The group performed the exercise while continuing to move around the circle. Frequent changes were made and exercises alternated with slow walking. The total guerrilla exercise work-out in a single day's program varied from five to ten minutes after the activities had been learned.

II. Second Week:

A. *First Day.*——Bulldozer or combative activities were taught. A five-minute run closed the period.

B. *Second Day.*—Grass exercises were practiced and field exercises were reviewed. This was followed by a five-minute run.

C. *Third Day.*—Field, guerrilla, bulldozer, and grass exercises were reviewed. This was followed by a five-minute run.

III. Third Week:

A. *First Day.*—Medicine ball and rope-skipping activities were introduced as activities to be used for individual participation and conditioning outside of class periods.

B. *Second Day.*—Half of the sections were introduced to the obstacle course. Instructions for clearing each obstacle were given. The other half of the sections were introduced to cross-country running. A distance of one and one-half miles was covered.

C. *Third Day.*—The previous day's procedure was reversed. The sections which had received instruction on the obstacle course were given cross-country running and vice-versa.

IV. Fourth to Eighth Weeks:

A. Military athletic events involving jumping, throwing, climbing, and running were gradually introduced. Activities in-

[3] S. C. Staley, *Conditioning Gymnastics* (New York: A. S. Barnes and Company, 1927) Preface.

cluded were: the running broad jump, the running pole jump, caber tossing, putting the shot, rope climbing, wall climbing, and the 200-yard carry.

B. Self-testing events were introduced and all-out records were kept for all students.

C. Initial test results for each military athletic event were recorded during the latter part of this period, following class sessions of learning and practice in all events.

V. Eighth to Sixteenth Weeks:

A. Conditioning exercises were continued.

B. Students practiced individually and instruction was given in each of the military athletic events. Regular reviews were held during this period which led to all-out effort in each event.

C. Continuous records of progress were kept for each item.

D. An intersectional tournament was held during the sixteenth week. Entries were accepted from all twenty-three sections for this tournament, following tryouts within individual classes. A total of 65 contestants entered the final competition and the tournament was so organized that a student might enter a single event or compete on an all-events basis. Events in the final competition were the rope climb (20 feet), running broad jump, cross-country run (3 miles), caber toss (36 pounds), wall climb (seven feet), and obstacle course run (one-half mile).

Medals were awarded to the winner of each single event, and to the winner, second, third, fourth, and fifth place in the "all-around." The Olympic Decathlon system of scoring was used to determine the "all-around" winners. Results of the first five students in each event are shown in Table III.

TABLE III

TOURNAMENT PERFORMANCES FOR BEST FIVE PARTICIPANTS IN EACH EVENT

Event	Unit	1	2	3	4	5
Rope Climb	sec.	6.4	6.4	6.6	6.6	6.8
36# Caber	ft.	28.4	26.6	26.5	26.3	26.0
Broad Jump	ft.	21.3	19.7	19.3	18.9	18.7
3-Mile Run	min.	17.8	18.1	18.2	18.2	18.5
Wall Climb	sec.	6.6	6.8	7.0	7.2	7.2
Obstacle Course	min.	4.0	4.2	4.3	4.3	4.4

SUMMARY OF RESULTS

The present study was undertaken to determine the effectiveness of the Military Athletics course which was developed to meet wartime needs in physical conditioning at the University of Illinois. It was decided that the criteria for effectiveness of the course would be the amount of improvement as measured by objective test scores kept throughout the semester. The tests were administered and recorded by members of the physical education staff who were teaching military athletics.

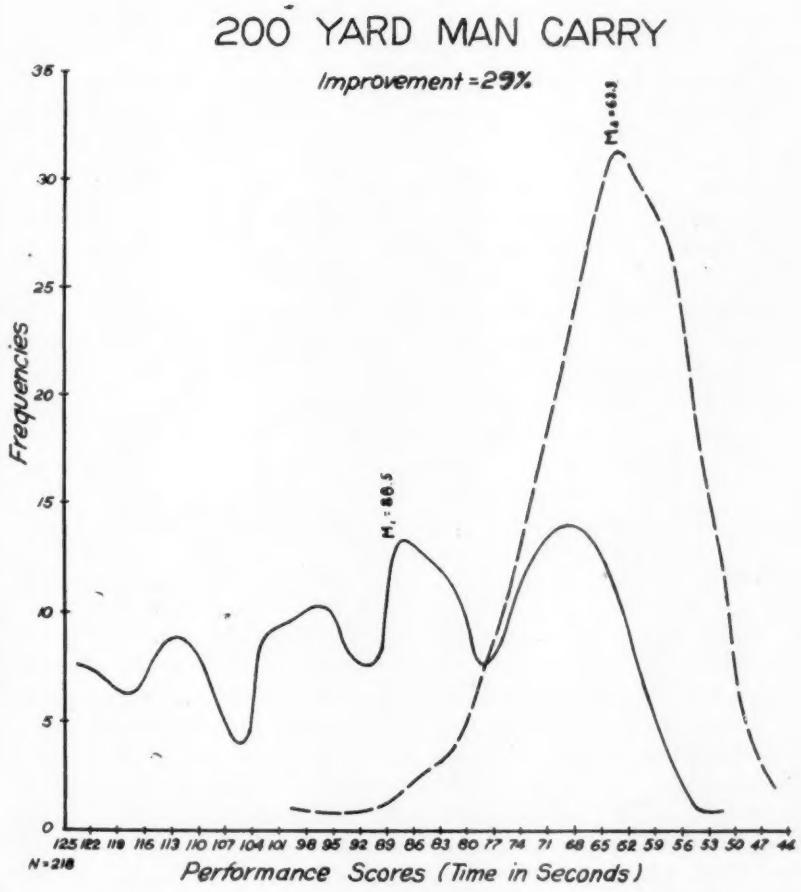

FIGURE 2. Improvement Curves for 200-Yard Man Carry, Military Athletics, 2nd semester. First test, solid line; final test, broken line.

The total number of students enrolled in this course in February, 1943, was 1,006, but a large portion of these did not complete the semester. The army Enlisted Reserve Corps affiliates were ordered to report soon after the beginning of the course and throughout the semester others were called to military service. Thus objective evaluation of the results of this program could only be attempted with the records of those students who were able to complete the semester. The course was planned and conducted as an outdoor course and some of the results obtained were subject to unfavorable weather conditions. Therefore, the results reported are those of students who completed the course, and whose original and final scores on each event were available for statistical study.

Students enrolled in the course were those who had passed sufficient items of the Illinois Motor Fitness Test to be eligible for Limited or Free Choice courses. Therefore, from the standpoint of physical condition, these students constituted a select group. They were in "reasonably good" physical condition at the start of the course. For this reason it was not expected that the percentage of improvement would be great, because of the possibility that many of the students were approaching a maximum in performance ability. However, it was found that for some items there were large percentages of improvement. Such percentages may be partly attributed to the learning factor as the events used have not ordinarily been included in college physical education programs.

In addition to learning the skills involved in unfamiliar events, it was necessary to motivate the students to put forth their maximum effort. According to Steinhaus,[4] performance is actually limited by the physiological capacity of the organs involved in a physical activity. But he goes on to say that a psychologic limit is usually reached long before actual physiological fatigue forces an individual to stop. Through the use of event records, and group and individual competition, each boy was motivated to put forth an all-out effort and scores improved markedly on some events. It was felt that the resultant postponement of the psychologic-fatigue limit was to some extent responsible for these increases.

Following is an analysis of each event, and the statistical data obtained from a comparison of the first and final tests. Critical ratios of the differences between the original and final means in each case were determined. The critical ratios for the three self-testing items were statistically significant as were those for seven of the nine military athletic events. These critical ratios indicate that satisfactory progress in conditioning was made by the students completing

[4] Arthur H Steinhaus, "Fitness and How We May Obtain It," *Proceedings of the National War Fitness Conference*, Forty-Eighth Annual Convention, A.A.H.P.E.R., Cincinnati, Ohio, 1943.

the course. These data are also presented in Table IV and V in more complete detail. Table IV indicates the summary of the results obtained for the three self-testing items taught in the course, and Table V is the summary of the results obtained for the nine military athletic events taught.

SELF-TESTING EVENTS

1. *Sit-ups.*—In this event, the starting position was on the back with the hands clasped under the head, knees straight, and feet together. The feet were *not* held. The critical ratio here between the two means was 5.1. A critical ratio of this size indicates that the difference between the two means is a statistically significant difference. It indicates that the difference is a true difference and not due to chance.

2. *Push-ups.*—In this event, the starting position was at front-leaning rest, and one push-up was scored each time the individual lowered his chest to the floor and pushed up to the original position.

3. *Leg lifts.*—In this event, the student started from a back-lying position with hands clasped behind the head, feet together, and legs straight. One leg lift was counted each time he raised both legs to a perpendicular position and lowered them to the floor.

TABLE IV

SUMMARY OF RESULTS OBTAINED FOR THREE SELF-TESTING ITEMS

Item	Number of Cases	Range 1	Range 2	Mean 1	Mean 2	Diff.	Per Cent Improvement	C.R.
Sit-ups	213	6-150	13-475	35	56	21	60	5.1
Push-ups	195	9-50	10-71	23	27	4	17	5.8
Leg Lifts	189	10-127	10-260	36	53	17	47	5.1

MILITARY ATHLETIC EVENTS

JUMPING EVENTS

1. *Running Broad Jump.*—This event was administered in the customary track and field manner and regulation jumping pits were used. Averages were based on 149 cases.

2. *Pole Jump for distance.*—In this event the individual used a vaulting pole and pit. The approach was made as for the pole vault. Measurements were made from the point where the feet left the ground to the nearest point of contact in the pit. Averages were based on 53 cases. The critical ratio here was not highly significant.

THROWING EVENTS

1. *Caber Toss.*—This event was adapted from the ancient Scottish sport of "Tossing the Caber." A log or caber approximately five inches in diameter, twelve feet long, and weighing 34 to 40 pounds was used. The caber was balanced in both hands and propelled up and out so that the force of the throw would cause the caber to fall away from the performer. Measurement was then taken from the throwing line to the point where the base of the

caber lay. If the caber fell back toward the throwing line after hitting the ground, no score was recorded. Averages were based on 179 cases.

2. *Shot put.*—This event was administered in the customary track and field manner. The 12-pound shot was used. Averages were based on 159 cases.

Climbing Events

1. *Rope Climb.*[5]—A twenty-foot rope climb was used. The timed climb started with the performer standing and the rope grasped with both hands at shoulder height. Averages were based on 218 cases.

2. *Wall Climb.*—This event was conducted over a seven-foot wall. The participants ran 10 yards to the wall, climbed over, and back. Time was checked as they touched the ground the second time over the wall. Averages were based on 69 cases. The mean difference was .8 seconds. The critical ratio was 1.9 and not statistically significant.

Running Events

1. *Two Hundred-yard Man Carry.*[6]—This event required a participant to carry a partner (10 pounds own weight) for a total distance of 200 yards. Four carries of 50 yards each were used and three changes were made. The carries were arm, single shoulder, fireman's, and hip. Averages were based on 218 cases. The critical ratio of 17.6 was the largest found for the twelve items studied.

2. *The Cross-Country Run.*—This event was conducted over a three-mile course consisting of hard surface and cinder roads. It was necessary that the students be conditioned to distance running before the full three miles could be attempted, so running during the early part of the course was limited to one and one-half miles. The improvement reported in this study is therefore the result of conditioning over a period of several weeks prior to the first time that three miles were run. Averages were based on 146 cases.

3. *Obstacle Course Run.*[7]—The University of Illinois Obstacle Course constitutes a very severe test of strength, power, and endurance. It was designed by S. C. Staley, Director of the School of Physical Education, and is planned so that it requires the use of all the large muscle groups. The over-all length of the course is one-half of a mile and consists of twenty-five obstacles spaced

[5] Figure 1 on page 382 shows improvement curves for Rope Climb.
[6] Figure 2 on page 385 shows improvement curves for 200-yard man carry.
[7] Figure 3 on page 390 shows improvement curves for obstacle course run.

over 440 yards with a 440-yard run to the finish line. Averages were based on 307 cases.

TABLE V

SUMMARY OF RESULTS OBTAINED FOR NINE MILITARY ATHLETIC EVENTS

Item	*Unit*	*Range 1*	*Range 2*	*Mean 1*	*Mean 2*	*Diff.*	*Per Cent Improvement*	*C.R.*
Broad Jump	ft.	11-18	12-22	14.8	16.3	1.5	10	7.7
Pole Jump	ft.	10-24	13-26	16.9	18.3	1.4	8	2.9
Caber Toss	ft.	11-29	13-29	17.5	21.2	3.7	21	10.9
Shot Put	ft.	19-40	20-42	29.8	31.2	1.4	5	3.3
Rope Climb	sec.	26-6	23-6	13.2	10.2	3.0	23	8.0
Wall Climb	sec.	20-5	17-5	9.8	9.0	.8	8	1.9
200-yd. Carry	sec.	123-50	99-45	88.5	63.3	25.2	29	17.6
Cross-Country Run	min.	29.3-19.8	28-17.8	24.3	22.0	2.3	9	8.6
Obstacle Course	min.	7.9-4.4	7.1-3.9	5.9	5.2	.7	12	12.4

CONCLUSIONS

The Military Athletics course was designed to contribute to the type of physical fitness required for military service. The percentages of improvement found for students participating in activities requiring jumping, throwing, climbing, lifting, and running varied from 5 per cent for the shot put to 60 per cent for the sit-ups. The critical ratios found indicated that progress was made in conditioning. Students who were not called by the Army or Navy Reserve Corps and were able to finish the course were motivated to put forth maximum effort. Attempts were made not only to teach the activities selected, but also to emphasize the meaningfulness of the events and activities as they related to military service.

It was difficult to evaluate statistically the full effect of the military athletic program because the percentages of withdrawals was great. However, statistical analysis indicated considerable improvement in physical condition for those students who completed the course.

The course was also felt to be of considerable value in that it provided an opportunity to test and develop physical education procedures which are not ordinarily included in college programs. Many of the items and techniques were found to be so useful that they have been incorporated into the A.S.T.P., V-12, and S.T.A.R. programs now in progress at Illinois.

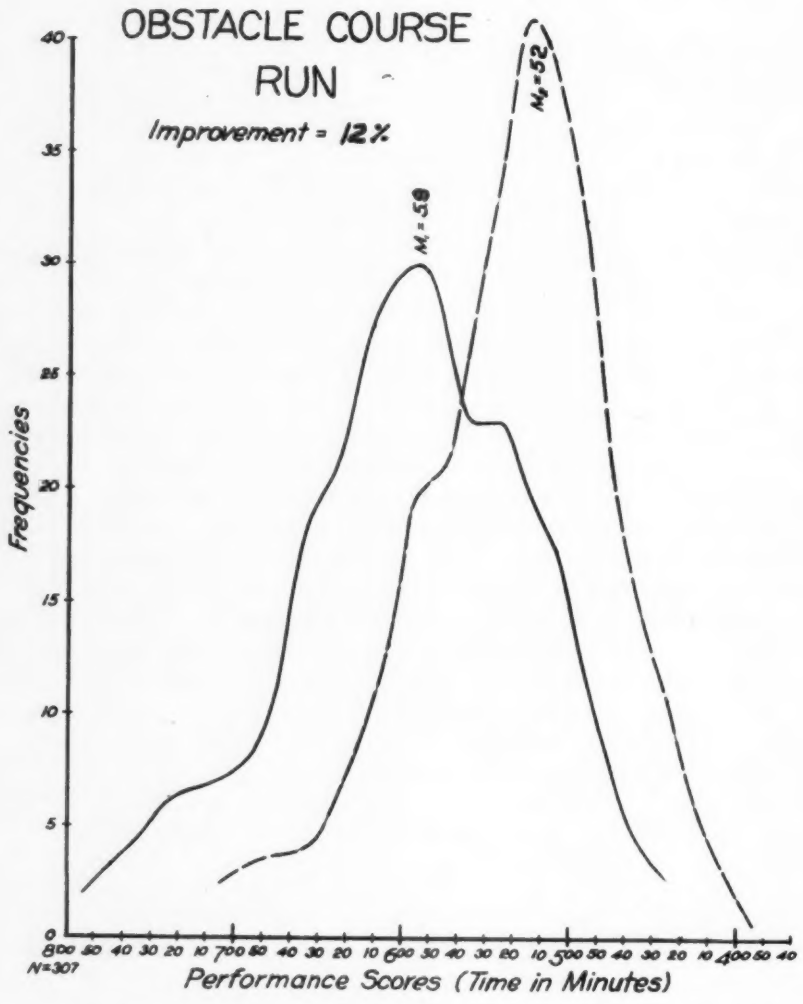

FIGURE 3. Improvement Curves for Obstacle Course Run, Military Athletics, 2nd semester. First test, solid line; final test, broken line.

Achievement Scale Scores for Wartime Swimming

By Jack E. Hewitt, Ed.D
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ONE important objective for a present-day swimming program in our colleges and training camps is to prepare men of the armed services for wartime water emergencies.

From the experiences of those who have had to save themselves in wartime water emergencies, the Army and Navy are in general agreement that there are a few fundamental water skills that every man entering the service should possess.[1] He must be able to abandon ship properly. He must be able to swim away quickly from a sinking ship, and he must be able to swim under burning oil or gasoline. On other occasions he may be forced to remain in the water for many hours or have to swim great distances before being rescued. Speed swimming in wartime has little value for the average swimmer, for the occasions are few when it has to be used. The one time that speed is essential is when the ship is sinking rapidly and the swimmer must escape the resulting suction. What is far more important than speed for students is the ability to swim the three essential wartime strokes (the elementary back stroke, the side stroke, and the breast stroke) in an easy and relaxed manner over a long distance.

The use of achievement scale scores for these particular swimming skills adopted by the Army and the Navy has been an immeasurable aid in facilitating the new aquatic program inaugurated over a year ago at the University of California. The University is just one of many such training bases in the United States which are confronted with large numbers of Army and Navy trainees who must be classified quickly into fairly homogeneous teaching groups at the start of each semester. Since students must be given an academic grade in physical education at the end of the training period, achievement scores are of considerable help. An objective grade which is based primarily on total improvement made can be given.

These achievement test scores are based on the results of over 3,000 performances made by men students registered for elementary, intermediate, lifesaving, and varsity swimming, members of the

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1 Jack E. Hewitt, "Swimming Goes To War," *Journal of Health and Physical Education*, September, 1943, 354-355.

armed services stationed at the University of California (Meteorology, Diesel Engineers, A.S.T.P., Army and Navy R.O.T.C., Navy V-12, and Marines) plus Navy officers who were in training at Treasure Island, San Francisco.

THE TESTS

Achievement scale scores have been worked out for the following events: 20-yard and 25-yard underwater swim, 15-minute swim for endurance, and the glide- and relaxation-ability test for the elementary back stroke, side stroke, and the breast stroke.*

All of the scores were placed in a frequency distribution and the means and standard deviations computed. For all the tests the mean was set at a scale score of 50. A scale score of 100 represents a performance of three-plus standard deviations above the mean, while a score of 0 represents a performance level of three-minus standard deviations below the mean. Such a point system has meaning to the pupil, for he can visualize exactly what his particular achievement score represents. It is seen that approximately only one and one-half per cent of the men in a thousand ever attain a score of 100 points.

In two events, notably the underwater swim and the 15-minute endurance swim, the distributions were slightly distorted. Special treatment was necessary in order to avoid a badly warped scale. In these two events, when the three standard deviations above the mean were computed, a score of 100 was impossible of attainment. In order to obviate this difficulty, it was necessary to take the best score obtained by the fastest swimmer and set his achievement point at the top of the scale. For this reason it will be noticed that for these two tests the increments for the scale values above and below the mean have different values. Other authorities in the test-and-measurement field who have had similar difficulties have found it necessary to resort to the same procedure.[2] To derive the step increment, the sigma for each test was multiplied by 3, and this value was divided by 50.

RELATIONSHIPS

It would appear logical that a student who possesses the ability to rest and glide on his back, side, and breast (important factors for wartime swimming) should also be able to swim a specified distance with these strokes with a minimum number of arm and leg actions. In order to determine probable relationships between the criteria or score given by judges as to the student's gliding and rest-

* See explanation and recommended standardized procedure for giving of tests at end of article.

2 Frederick W. Cozens, Martin H. Trieb, and N. P. Neilson, *Practical Education Achievement Scales for Boys in Secondary Schools* (New York: A. S. Barnes Company, 1936) 154.

ing ability and the number of actual strokes required for a 50-yard swim, correlations were made for three essential wartime strokes, the elementary back stroke, the side stroke, and the breast stroke. For the elementary back stroke a chance sampling of 288 University students was used. Three judges stood on opposite sides of the pool and counted the approximate seconds each swimmer could hold the glide. For example, if a student could hold the glide 8 counts, he was given a score of 8, and so forth. Counts were made for three complete strokes and the score averaged. This score then was correlated with the total number of strokes required to cover the 50 yards for the elementary back stroke, the side stroke, and the breast stroke. Pearson product moment r for the elementary back stroke was $r=.90\mp.08$, and correlation of the judges' scores on the back stroke was $r=.92\pm.10$. Correlation of the ability to hold the glide for the side stroke with the number of required strokes for 50 yards gave an $r=.86\mp.02$. Correlation of the judges' count on the side stroke was $r=.99\mp.007$. Correlation of gliding in the breast stroke and the number of required strokes for 50 yards gave an $r=.91\mp.03$. (See Table I). Correlation of the judges' awards for the breast stroke was $r=.93\mp.03$. These correlations are all high enough to show a significant relationship between gliding and resting ability (important factors for endurance swimming) and the ability to swim a minimum number of strokes for 50 yards.

Form swimming in the side stroke, when correlated with the number of strokes required for 50 yards, gave an $r=.62\mp.03$. Three judges separately marked a total of 288 University students on form, using a scale from 0 to 10 points. One plausible explanation for this correlation not being higher is that it is possible for students to use an improper kick and thus have their form points pulled down, yet still swim the 50 yards with a low number of strokes. This correlation, however, is high enough to show that there is considerable relationship between stroke efficiency and the ability to swim 50 yards with relatively few strokes. For war swimming form is not so essential as the ability to swim any style of stroke in an easy, restful manner.

TABLE I

CORRELATION OF THE ABILITY TO HOLD THE GLIDE AND THE NUMBER OF STROKES REQUIRED TO SWIM 50 YARDS

Stroke	Gliding ability vs. total number of strokes required for 50 yards	N
Elementary Back	$r = .90 \mp .08$	288
Side Stroke	$r = .86 \mp .02$	230
Breast Stroke	$r = .91 \mp .03$	204

Additional tests such as jumping off from a tower, treading water, floating, blowing up clothes with air, and disrobing are not

amenable to a point-scale system. These events are important, however, and should be included in the wartime program and graded on a pass-or-fail basis.

RECOMMENDED STANDARDIZED PROCEDURE FOR GIVING TESTS

Twenty and 25-yard underwater swim.—Start from a dive and swim the entire distance underwater. The finish must be made underwater. No score is given if any part of the body comes to the surface during the test. Any style of swimming may be used. *Scoring:* Time in seconds.*

Fifteen-minute swim for endurance.—Start in the water and use the regulation push-off. Any style of swimming may be used. Only above-water push-off's are allowed when making the turn. No resting is allowed at turns. *Scoring:* Tabulate lengths and convert into yards.* Instructor blows a whistle when the 15 minutes are up and all students stop swimming. If the student is over half a length at the finish allow a full length, but if the student is under half a length do not consider the extra feet.

Glide and relaxation ability—number of completed strokes that are required for a 50-yard swim for the following strokes:

Elementary Back Stroke.—Start in the water using the regulation above-water push-off both at the start and at the turn. Use either a frog kick or any modification of it. Arms must remain in the water at all times, but they may be raised above the shoulders on the recovery. No arm or leg action is allowed on the push-off. *Scoring:* Count every leg-kick made as one complete stroke and every push-off made as one additional stroke. Only one leg action is allowed per arm action.

Side Stroke.—Start in the water using the regulation push-off for start and for turn. Only the underwater style side stroke may be used. Use regulation side stroke kick or a modification of it. No arm pull or leg-kick is allowed on the push-off. *Scoring:* Count every leg-kick made as one complete stroke and each push-off as one additional stroke. Only one leg action is allowed per arm action.

Breast Stroke.—Start in the water using the regulation above-water push-off for start and for turn. Use conventional frog-kick or any modification of it. No arm-pull or leg-kick is allowed on push-off. No butterfly stroke is allowed. *Scoring:* Count every leg kick made as one complete stroke and each push-off count as one additional stroke. Only one leg action is allowed per arm action.

* Refer to Table II.

TABLE II

HEWITT SWIMMING ACHIEVEMENT TEST SCALES—25-YARD POOL

Underwater Swim Seconds		15-Minute Endurance Swim	Glide and Relaxation Ability Number of strokes used			
			E. Back	Side	Breast	
20 Yards	25 Yards	Yards	50 Yards	50 Yards	50 Yards	Points
11.0	15.1	1025	9	9	9	100
11.1	15.3					99
11.2	15.4					98
11.3	15.6	1000				97
11.4	15.7			10		96
11.6	15.8				10	95
11.7	16.0		10			94
11.8	16.1	975				93
11.9	16.2					92
12.0	16.4			11		91
12.1	16.5	950			11	90
12.2	16.8					89
12.4	16.9		11			88
12.6	17.0			12		87
12.7	17.2	925				86
12.8	17.3					85
12.9	17.5				12	84
13.0	17.6	900				83
13.1	17.7		12	13		82
13.3	17.9					81
13.4	18.0	875				80
13.5	18.2				13	79
13.6	18.4					78
13.7	18.5		13	14		77
13.8	18.7	850				76
13.9	18.8					75
14.1	19.0					74
14.2	19.1	825			14	73
14.3	19.3			15		72
14.4	19.4		14			71
14.5	19.5	800				70
14.6	19.7					69
14.7	19.8			16		68
14.9	20.0	775			15	67
15.0	20.2					66
15.1	20.3		15			65
15.2	20.5			17		64
15.3	20.6	750				63
15.4	20.7				16	62
15.6	20.8					61
15.7	20.9	725	16	18		60
15.8	21.0					59
15.9	21.1					58
16.0	21.2	700				57
16.1	21.3				17	56
16.2	21.4		17	19		55
16.3	21.5					54
16.4	21.6	675				53
16.5	21.7					52
16.6	21.8					51
16.7	21.9	650	18	20	18	50
16.9	22.1					49
17.1	22.3					48
17.3	22.6		19	21	19	47
17.4	22.8					46

Underwater Swim Seconds		15-Minute Endurance Swim	Glide and Relaxation Ability Number of strokes used			
20 Yards	25 Yards	Yards	El. Back 50 Yards	Side 50 Yards	Breast 50 Yards	Points
17.6	23.0	625				45
17.8	23.2		20	22	20	44
18.0	23.4					43
18.1	23.7			23		42
18.3	23.9	600	21		21	41
18.4	24.0					40
18.6	24.2			24		39
18.8	24.4		22		22	38
19.0	24.7			25		37
19.1	24.9	575			23	36
19.3	25.0		23			35
19.4	25.2			26		34
19.6	25.4				24	33
19.8	25.7	550	24			32
20.0	25.9			27		31
20.1	26.0				25	30
20.3	26.2		25	28		29
20.4	26.4					28
20.6	26.7	525			26	27
20.8	26.9		26	29		26
21.0	27.0					25
21.1	27.2			30	27	24
21.3	27.4	500	27			23
21.6	27.7					22
21.8	27.9			31	28	21
22.0	28.0					20
22.1	28.2		28			19
22.3	28.4	475		32	29	18
22.6	28.7					17
22.8	28.9		29		30	16
23.0	29.0			33		15
23.1	29.2	450				14
23.3	29.4		30		31	13
23.6	29.7			34		12
23.8	29.9					11
24.0	30.0				32	10
24.1	30.2	425	31	35	33	9
24.3	30.4					8
24.6	30.7				34	7
24.8	30.9		32	36		6
25.0	31.0					5
25.1	31.2	400				4
25.3	31.4		33	37	35	3
25.6	31.7					2
25.8	31.9					1
26.0	32.0	375	34	38	36	0

Report of the Test Committee of the Western Society of Departments of Physical Education for Women In Colleges and Universities

By Anna Espenschade, *Chairman*

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THE present widespread realization of the need for a high degree of physical fitness for every individual has placed a renewed emphasis upon measurement. Fitness implies the ability to perform productive and continuous work. Some components of fitness, then, would be physical strength, skill, organic vigor, and endurance. Physical education is directly concerned with the development of all of these components.

The amount of development which an individual attains, however, cannot be readily assessed. Certain fairly reliable tests measure the ability of the individual to manage his own body and to handle objects. Thus, they may be said to measure the amount of skill and effective strength which the individual possesses. An estimate of organic power may be made through respiratory-circulatory tests and measures of strength and endurance. The measurement of development or change in physical status must be made by repeating tests. It is generally recognized that functional efficiency increases through exercise which is severe enough to push the body to the approximate limits of endurance. If a variety of tests to sample different functions is given and later repeated, then improvement in test performance should indicate an increase in efficiency and therefore improved physical fitness.

The fitness of any individual may be classified roughly as ideal or superior, normal or average, substandard or inferior. In order to classify individuals it is necessary to have test norms. Then, too, norms are needed in order to measure improvement upon repetition of the test in standard scale units. Norms are available at present

The writer wishes to express her indebtedness to Dr. Irene Palmer for help in the initial selection of tests; to Mrs. Ruth Waterman of Fresno State College for sending test scores; to Miss Florence Hupprich and Miss Marjorie Dennis of Oregon State College for giving and repeating tests in many classes; to Mrs. Glass, Miss Coleman, and Miss Bernhard of the University of California for reporting tests given in their classes.

for a number of tests of sports skills and for a few measures of general coordination.[1]

The Western Society appointed a Test Committee in the summer of 1942 to select practical tests for college women which may be used to measure aspects of physical fitness. The Test Committee[2] returned a preliminary report in the fall of 1942 in which certain tests for the measurement of general body coordination were listed. Members were urged to give some of these tests, to repeat them after approximately a three months' interval and to send scores to the chairman for analysis. These results could be used (1) to review the reliability of the tests, (2) to compare scores in certain tests with the published norms and to revise these latter if necessary, (3) to establish norms for other tests, (4) to determine the amount of improvement which may be expected to take place over a short period of time.

The Committee discussed measures of strength, endurance, and organic power but preferred to carry on further experimentation with these tests before recommending them for general use. Since the presentation of the Preliminary Report, two national groups[3] have proposed specific tests for strength and endurance, so the Western Society will not continue independent investigation.

The following tests to measure general body coordination were listed. They were chosen because they are known to be fairly reliable and because they sample various aspects of motor performance. It was suggested that if only a few tests could be given, a run, a jump, and a throw should be selected since experiments have shown that these three measures correlate rather well with the results of a

Test	*Classification*
50-yard Dash Dodging Run (Cozens)	Speed of legs
Jump and Reach Standing Broad Jump	Strength of legs
Throw for Distance (Softball) Basketball Speed Pass	Coordination of arm and shoulder girdle
Scramble* Burpee	Agility
Throw and Catch (Softball)* Edgren Ball Handling (Basketball)	Eye-hand coordination

*Descriptions of these events are appended to this article.

1 Cozens, Cubberley, Neilson, *Achievement Scales in Physical Education Activities for Secondary School Girls and College Women.* (New York: A. S. Barnes and Company, 1937).

2 Dr. Irene Palmer, San Jose State College, Dr. Anna Espenschade, University of California, Berkeley.

3 "Performance Levels for High School Girls," National Section on Women's Athletics; and "Physical Fitness for Students in Colleges and Universities through Health and Physical Education," Federal Security Agency, U. S. Office of Education.

very extensive battery of tests and that they are reliable enough to show change in physical status over a period of time. If many tests could be given, a better diagnosis of individual strengths and weaknesses would be obtained and differential improvement might be noted.

Relatively few test scores were received by the chairman, but the following results shown in Table I will be of use to all in evaluating

TABLE I

TEST RESULTS

	First Test			*Repeated Tests (7-10 weeks)*		
	No.	*Mean*	*Sigma*	*No.*	*Mean 1*	*Mean 2*
Dodging Run	603	25.2 sec.	1.7	65	26.2 sec.	25.2 sec.
	(Norm)	(69)*			(61)	(69)
Jump and Reach	626	13.2 in.	2.2	55	14.2 in.	14.4 in.
		(50)*			(57)	(58)
Basketball-Speed Pass	570	58.5	8.4	41	65.5	72.0
		(41)*			(56)	(70)
Burpee	523	4.0	0.6	98	4.4	4.8
		(25)**			(34)	(38)
Edgren Ball Handling	100	23.3	4.7	.78	23.9	21.1
		(56)*			(54)	(64)

*Cozens, Cubberley and Neilson, *Measuring Achievement in Physical Education Activities.*

**C. H. McCloy, *Tests and Measurements in Health and Physical Education.*

similar work. A number of reports were received of one administration of certain tests,[4] a few of repeated tests.[5] All data were combined for the first testing scores. Comparable tests are presented separately.

The reliability of the difference in scores from the first to the second testing was studied for each class of matched individuals. As the Edgren test, for example, was given to tennis classes as well as to basketball classes it was thought that some differences in gains due to specific practice effects might be noted. Although the basketball classes tend to show a higher level of mean performance in this event, the relative gain is fairly comparable in all classes.

TABLE II

IMPROVEMENT IN EDGREN TEST

Activity	*Mean 1*	*Mean 2*	*Chances of a true difference**
Elementary Tennis	25.6	21.9	90 in 100
Elementary Tennis	25.8	23.0	80 in 100
Elementary Basketball	25.4	21.1	75 in 100
Intermediate Basketball	19.8	18.9	60 in 100
Intermediate Basketball	22.5	18.7	75 in 100

*From Fisher's Table of the Distribution of *t* for Certain Probability Levels.

In no event were wholly reliable differences between first and second tests found. The chances of a true difference in the Dodging Run and Speed Pass were about 75 in 100; in the Burpee, 60 in 100;

4 Fresno State College, University of California, Berkeley.
5 Oregon State College, University of California, Berkeley.

and in the Jump and Reach, 50 in 100. It is interesting to note that *every girl* improved in the Speed Pass. This was true for no other event although the percentage of those whose second score was below the first is very small.

Some comment regarding the published norms for the above events should be made. Results of this study indicate that those for the Dodging Run are too low. All runs in this study were given indoors on a gymnasium floor. A number of results were reported which cannot be scored on the present scale. No scores falling below 10 on the present scale were recorded. Since the scale is an equal increment one, it can readily be revised by subtracting 10 from each present scale score and extending the scale upward ten additional steps. The norms for the Burpee test are those listed for high school girls. Obviously, they are entirely too high and a revision of this scale is badly needed.

The number of scale points improvement to be expected on the average for each test may be taken from Table I. As the scales increase by equal increments, equal amounts of improvement at any level of performance will score equally. The scores in this study were inspected to discover whether there was a tendency for girls who had low scores on the first test to improve more than those who made high scores. This was not the case. The level of performance cannot be said to be the deciding factor in amount of improvement shown. Thus it may be assumed that the number of scale points improvement during a term in any event may serve as an index of the changed "motor fitness" of the individual.

Appendix

SCRAMBLE

Floor layout: Two blocks or boards should be firmly fixed so as to afford a firm surface perpendicular to the floor and 10 yards apart (a wall may be used as one end).

Description: The contestant starts lying supine with her feet firmly against the block at one end of the course. On the signal, "Are you ready? Go!" she gets up, runs to the other end, lies down on her back with feet against the block, slaps the floor three times with her hands (thus making sure that the subject actually lies down) gets up, runs back to the start, lies down and slaps the floor three times, gets up once more, runs to the other end, lies down and slaps the floor three times. The subject runs 30 yards, gets up three times, lies down three times.

Rules:

1. The time elapsing from the word "Go!" to the instant the runner slaps the floor the final time is taken in seconds and tenths.
2. The contestant must place her feet firmly against the blocks at the ends of the course each time she lies down.
3. Two trials shall be allowed and both scores recorded.

THROW AND CATCH

Description: A restraining line is marked 15 feet from a high smooth wall. At a signal, "Are you ready? Go!" the ball is thrown against the wall

and caught on the rebound. The girl continues to throw and catch as rapidly as possible until the signal "Stop!" is given. All throws and catches must be made from beyond the restraining line. The time allotment is 30 seconds. The score is the number of balls caught on the fly within the time limit.

Rules:

1. Each girl has two trials. A short rest should be permitted between trials.

2. The final score is the sum of balls caught in two trials. (Record trial scores separately.)

Motor Ability Tests for College Women

By M. Gladys Scott
State University of Iowa

MOTOR ability tests are used frequently for women entering college physical education courses. These serve to determine quickly the needs of each individual and to section classes for greatest benefit to students.

Test batteries have been recommended previously by this writer.[1] There is comparatively little difference between many of these batteries in their effectiveness in classifying students. Equipment, time, and other possible uses of the tests will be the deciding factors in choosing one. The following are especially recommended:

1. .7 basketball throw + 2 dash + 1 passes + .5 broad jump
2. 2 basketball throw + 1.4 broad jump — 1 obstacle race
3. 1.5 basketball throw + 2 dash + 1 broad jump.

The obstacle race presented in the previous report had some disadvantages, namely, it seemed too time consuming; some students were afraid of it and therefore could not perform adequately; very occasionally an accident occurred. Therefore, it seemed advisable to modify this race. The hurdles and stool stepping appeared to be the parts most needing change. By eliminating the hurdles entirely

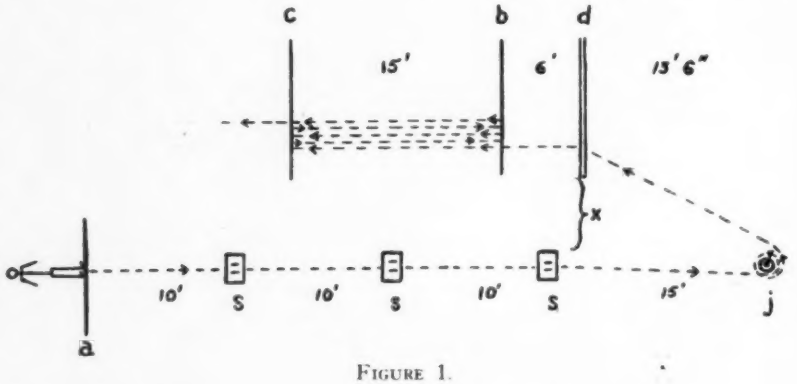

Figure 1.

a. starting line
b. line for shuttle
c. finish line
d. boom (18" high)
j. jump standard
s. spot on floor (12" x 18")
-. path of runner
x. distance from end of boom to line of inner sides of spots (4' 4").

1 M. Gladys Scott, "Assessment of Motor Ability of College Women Through Objective Tests," *Research Quarterly* (October, 1939).

the race was shortened by about thirty per cent in running time. It was decided arbitrarily to drop that part. The stool-stepping part was compared with another form duplicating it in every respect except in substitution of spots on the floor instead of the stools. The performance on these two forms correlated .60 for 88 cases. The spots were substituted in the race. All tests were retaken by a number of subjects. Scores on the three batteries listed above were correlated with the following results:

Items Correlated	No. of Subjects	r
Long obstacle—short obstacle	94	.780
#2 with long obstacle—#2 with short obstacle	112	.988
#1—#2 with long obstacle race	126	.945
#1—#2 with short obstacle race	112	.943
#3—#2 with short obstacle race	112	.976

The short obstacle race had a reliability on 87 cases of .91 for two trials on successive days. A diagram of the short form appears in Figure 1.

The short obstacle race was substituted for the longer form. For the last five years the short form has been used on entering students at the University of Iowa with no accidents occurring from it. Therefore, it seems to have satisfied one of the greatest objections to the previous form. During that same five-year period, scores for batteries 1 and 2 have been computed for all students and used in advising students. For 200 students selected at random from the last two years these two batteries yield a correlation coefficient of .94. It seems possible, therefore, that either battery may be used alone if one is not interested in the separate items in the batteries.

T-scales for each test and both batteries are appended. The number of cases included in each scale is given. In every test it was found that the scale no longer showed appreciable fluctuations from the addition of more cases from successive classes.

CONCLUSIONS

On the basis of evidence presented here and on experience with the tests the following conclusions seem justified:

1. The shortened obstacle race may be combined in batteries with almost identical results to those of the longer race in measuring motor ability.

2. The shortened obstacle race seems to eliminate practically all sources of danger in administering the race. (It is assumed, of course, that all students running the race have been given medical approval for activity.)

3. The T-scales indicate the range of ability and performance to be expected from entering freshmen in college.

T-Scores for College Women

Wall Pass (1187)*	Basketball Throw (ft.) (1162)*	Broad Jump (in.) (1167)*	4-Sec. Dash (yds.) (1173)*	Obstacle Race (sec.) (1230)*	G.M.A.(1) (1880)*	G.M.A.(2) (1228)*	T-Score
18							84
	75	84-85	29				83
							82
		82-83				206-207	81
	65				146-147	204-205	80
17						202-203	79
	64	80-81		20.0-20.4	144-145	194-201	78
	63		28		142-143	192-193	77
16	62				140-141	190-191	76
	60				138-139	188-189	75
15	59				136-137	186-187	74
	58	78-79		20.5-20.9		184-185	73
14	57		27		134-135	182-183	72
	56	76-77			132-133	180-181	71
	55			21.0-21.4		178-179	70
13	54	74-75			130-131	176-177	69
	53				128-129	170-175	68
	52		26	21.5-21.9		168-169	67
	51	72-73			126-127	164-167	66
	50			22.0-22.4	124-125	162-163	65
12	49	70-71	25		122-123	160-161	64
	47			22.5-22.9		156-159	63
	46	68-69			120-121	152-155	62
11	45			23.0-23.4	118-119	150-151	61
	44	66-67	24		116-117	148-149	60
	43			23.5-23.9		146-147	59
	41	64-65			114-115	142-145	58
	40		23	24.0-24.4	112-113	140-141	57
	39					136-139	56
	38	62-63		24.5-24.9	110-111	134-135	55
10	37				108-109	132-133	54
	36	60-61	22	25.0-25.4		130-131	53
	35				106-107	126-129	52
		58-59		25.5-25.9	104-105	124-125	51
	34					122-123	50
	33	56-57	21	26.0-26.4	102-103	120-121	49
9	32				100-101	116-119	48
	31			26.5-26.9		114-115	47
		54-55	20	27.0-27.4	98-99	110-113	46
	30					108-109	45
		52-53		27.5-27.9	96-97	106-107	44
	29					102-105	43
8	28	50-51	19	28.0-28.4	94-95	100-101	42
	27			28.5-28.9	92-93	98-99	41
	26	48-49		29.0-29.4		96-97	40
					90-91	94-95	39
		46-47	18	29.5-29.9		90-93	38
	25			30.0-30.4	88-89	88-89	37
7		44-45		30.5-30.9	86-87	84-87	36
	24		17			82-83	35
	23	42-43		31.0-31.4	84-85	80-81	34
				31.5-31.9	82-83	78-79	33
	22	40-41			80-81	76-77	32
6	21		16	32.0-32.4		74-75	31
		38-39		32.5-32.9	78-79	72-73	30
	20			33.0-33.4		70-71	29
		36-37	15	33.5-33.9	76-77	66-69	28
5	19					64-65	27

T-SCORES FOR COLLEGE WOMEN

Wall Pass (1187)*	Basketball Throw (ft.) (1162)*	Broad Jump (in.) (1167)*	4-Sec. Dash (yds.) (1173)*	Obstacle Race (sec.) (1230)*	G.M.A.(1) (1880)*	G.M.A.(2) (1228)*	T-Score
		34-35		34.0-34.4	74-75	62-63	26
	18	32-33	14	34.5-34.9		60-61	25
				35.0-35.4	72-73	58-59	24
4	17	30-31	13			56-57	23
	16				70-71	54-55	22
	15			37.0-37.4		38-39	21
3				37.5-37.9	68-69		20
2					66-67		19
	13				64-65		18
1		24-25	12				17
				38.0-38.4			16
					62-63		15

* Indicates the number of subjects on which the scale is based.

The Construction of Knowledge Tests in Selected Professional Courses in Physical Education

By Esther French
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INTRODUCTION

THE philosophy underlying the modern testing program is that of providing opportunity for the optimum development of the individual in relation to mutual service to a democratic society. The extensive use of tests in educational institutions has been duplicated in industry by civil service examiners, state examiners for licensing pharmacists and doctors, bar examiners for lawyers, and examinations of various types given by personnel workers. Of fairly recent vintage are the aptitude tests for defense workers and the psychological tests for the various branches of the armed services. Since examinations have a vital effect on the lives and fortunes of many people, the responsibility of those persons engaged in constructing them is great.

Knowledge tests in physical education are in a stage that might be termed "infancy." They have been used in some institutions for grading and for promotion, but the results have not been entirely satisfactory. Good objective tests require more time and effort than the average teacher can give. The results have varied from complete avoidance and condemnation of objective tests, or the use of quickly formulated and inadequate tests, to a few carefully constructed ones rebuilt on the basis of earlier results and analyzed for their efficiency.

A recent trend in education is the use of tests in guidance. If the great American ideal, to give everyone his utmost chance, is to be realized, tests which reveal fundamental factors must be developed. If "desirable changes in the learner" is accepted as our purpose, then measuring instruments must be made available to enable us to evaluate the effects of the educative process.

The first published test in physical education was a basketball test by Bliss[7*] in 1929. His test included 30 questions on rules and 45 on technique. No evidence is presented of its being either reliable or valid. The second test to be published was a soccer test by Knighton[20] in 1930. No report was made on the reliability or valid-

This study is an abstract of a doctoral dissertation, State University of Iowa, May, 1942.

* Superior figures refer to numbered bibliography at end of article.

ity. The test consisted of 35 questions, 25 of which were true-false. This was a test on rules, and appears best suited to players with limited experience. Rodgers and Heath[34] published a baseball knowledge test in 1931 for fifth- and sixth-grade boys. This test consisted of 100 true-false items on rules and strategy. The reliability is high; the validity would depend on the use. It appears to have value as a teaching device. The same authors published a soccer test for fifth- and sixth-grade boys in 1932. The same comments as those regarding their baseball test apply here.

Two tests for use in training basketball officials (girls' rules) have been developed, one by Schleman[38] in 1932 and one by Scott[40] in 1937. They are primarily teaching devices.

Hemphill[17] recognized the need for information tests and published in 1932 a detailed study consisting of several tests for high school boys. The reliabilities ranged from .66 to .87.

A golf knowledge test was published by Murphy[28] in 1933. She selected the test items from statements made in golf textbooks, considering this a check on validity.

Tests for officials in field hockey for women were constructed by Grisier[14] in 1934 and French[50] in 1939. Both tests were validated by comparing the performances on the test of rated officials with non-rated officials and with players.

Four knowledge tests in tennis have been published: Wagner[51] in 1935, Snell[47] in 1936, Hewitt[18] in 1937, and Scott[42] in 1941. Wagner's report included but ten questions and no attempt was made to validate the test. Snell's test, including 45 questions, has a comparatively low reliability and is quite heavily weighted with items on rules. Hewitt included both men and women in his study. He had 100 questions, fifty-five of which were true-false, 15 multiple choice, 15 completion, and 15 matching forms. He compared the scores made by his male subjects with the scores made on the Snell examination and found a high correspondence between the two tests. Scott's examination was for beginners and intermediates. The items to be retained were selected on the basis of difficulty rating and the index of discrimination. The Elementary Test is composed of 25 multiple choice items and 41 true-false; the Intermediate Test has 21 multiple choice and 30 true-false items. The tests appear satisfactory for measuring the tennis knowledge of general college classes.

The only rhythm knowledge tests published to date are those by Thompson[49] in 1933 and by Shambaugh[44] in 1935. Thompson has made no statistical study to indicate the worth of the test; the questions are of value as illustrative material. Shambaugh has a reliable test in folk dancing for general college students.

In 1937, Schwartz[39] reported a study of a basketball test for

high school girls. She was assisted by fifty-four women, "well versed in the theory and technique of basketball." No report was made on the reliability. The test appears too easy for an achievement test.

The two most extensive testing projects have been those reported by Snell[45, 46, 47] in 1935 and 1936 and by Scott[41, 42, 43] in 1940 and 1941. The former project was developed by the Department of Physical Education for Women, University of Minnesota, and includes tests in the following activities: archery, baseball, basketball, field hockey, fundamentals, golf, riding, soccer, tennis, and volley ball. Each test has 45 questions of the multiple choice type, with reliabilities ranging from .51 to .85. They were constructed for general college students and were validated on "expert opinion." They have been of value to the profession. The tests reported by Scott are those developed by the Research Committee of the Central Association of Physical Education for College Women, and include tests for the following activities: badminton, swimming, and tennis. The individual items were based on materials commonly taught in college classes in the Central District, as revealed by questionnaires. The items to be retained were based on an index of discrimination and a difficulty rating. The tests are intended for general college students.

Tests for officials in basketball, softball, tennis, and volley ball have been prepared by various persons for the Women's National Officials' Rating Committee. They are revised frequently, usually without validation, and are composed of questions that concern primarily the official: rules and officiating techniques.

None of the specially organized test-building agencies, such as the Cooperative Test Service and the various state and regional testing services, has prepared tests in physical education.

This is a complete survey of published tests in physical education to April 1, 1942. An analysis of these indicates that there is nothing that meets our purpose.

STATEMENT OF THE PROBLEM

It is the purpose of this study to construct knowledge tests which will serve as a partial determiner of the technique requirements for women students majoring in physical education at the State University of Iowa. The following activities are included: badminton, basketball, body mechanics, canoeing, field hockey, folk dancing, golf, recreational sports (aerial darts, bowling, deck tennis, handball, shuffleboard, table tennis, tetherball), rhythms, soccer, softball, stunts and tumbling, swimming, tennis, track and field, and volley ball.* This includes practically all of the technique courses taught during the first two years of the professional course.

* If there is sufficient demand, these tests will be made available to other institutions. Address the author for information.

PROCEDURE

The procedure followed in attempting to solve this problem consisted of the following steps:

1. Clarification of objectives.
2. Outlining of courses.
3. Planning the distribution of items by content classification.
4. Preparation of items.
5. Critical evaluation of items.
6. Selecting the subjects.
7. Administering the tests.

Clarification of Objectives

For this particular situation it was decided that the ultimate objective was to build items suitable for a diagnostic test (battery of achievement tests). The problem is measuring the knowledge that the student possesses and how well she understands what she has learned. The tests should measure the student's ability to use her knowledge, to generalize, to make applications; therefore, they should not be built as learning-teaching devices. The items should discriminate between students of all levels of ability but particularly between those students above the lowest quartile of the ability distribution.

It was decided to experiment with the use of diagrams wherever they appeared advantageous in furnishing a compact device for getting at complex ideas or spatial relations. The questions on rules were to be limited to those rules essential to intelligent play. It was decided to build tests for the experimental battery of such length that the majority of students could complete each one in fifty minutes; also, to make them be "power tests," with gradation of items according to predicted difficulty.

Each test was to be weighted with items in proportion to the emphasis given in the technique course itself. Less emphasis will be placed in the test on analyzation of skills than is true in the course, since individual skills will be measured by skill tests. "When to use what" will be tested in the knowledge test, as will team tactics and strategy, in the courses in which they are a part.

Outlining of Courses

Following a meeting of the staff of the Department of Physical Education for Women, at which time the objectives of the study were discussed and the plans outlined, each instructor was given a form for outlining her course or courses and a sample outline. She was also asked to list the reading assignments, table of contents for required notebooks, and to include copies of mimeographed materials given out in class and any examination questions which she had found through experience to be good.

Planning the Distribution of Items by Content Classification

The content of each course was reviewed for skills, generalizations, ideational content, and specific information. Questions were raised such as "Why is this worth learning?" and "To what objectives does this contribute?" The usual procedure included submitting a tentative distribution to the instructor of the course and then discussing it with her and revising it until the optimum distribution appeared to have been reached. The distribution which is included here is typical of the team sports included in the battery. Distribution of items by content classification in Soccer Knowledge Test:

	Number of Questions	*Per Cent*
Analysis of individual techniques (How to do in good form)	3	5
Analysis of Game Situations and Use of Skills	8	13
General Knowledge (History, Selection and Care of Equipment, Safety Precautions, Differences between Field Ball, Speedball, Soccer)	3	5
How to Avoid Fouling	3	5
Placement of Passes, Throw-Ins, Kicks for Goal	2	4
Tactics and Areas of Play	22	36
Rules Essential to Intelligent Play	15	25
Terminology	4	6
	60	

Preparation of Items

It was decided to build multiple choice items for the following reasons:

1. They can be adapted to test for any depth of understanding.
2. They can be made completely objective in scoring and are easily adapted to answer sheets.
3. It is possible to detect readily any non-functional material in the responses, thus facilitating revision of the question for the final battery by elimination of responses.
4. They test for the student's ability to eliminate incorrect responses as well as to select the correct response directly.
5. They do not require correction for guessing.
6. They seem best adapted to the type of material involved.
7. They seem to have more advantages and fewer disadvantages than the other commonly used forms: true-false, multiple response, matching forms, and completion.

In preparing the items for each test, the course outline was studied, the notebook table of contents and the distribution of items were consulted, the reading assignments and the mimeographed materials were read, along with standard reference books and articles, until familiarity with the content of the course and the objectives of the course was obtained. (Six of these courses are taught by the writer, and she has had experience in all of the activities included as a participant and has taught the majority of them.) The suggestions

concerning the construction of multiple choice items from Hawkes, Lindquist, and Mann[15]* were observed.

Following the preparation of tentative items, the usual procedure included examination of the items by the thesis director and the instructor of the course and one or more other teachers familiar with the activity or familiar with testing. Suggestions for revisions and for additional items were obtained in this manner.

Critical Evaluation of Items

After the items were prepared, they were reviewed one by one in considerable detail, making use of the following check list adapted from class notes, "Improvement of Written Examination," by Dr. E. F. Lindquist.

1. Exactly what is this item intended to measure?
2. Is the intended purpose of the item acceptable? Is it important that the item be included; does it test for something significant?
3. Is there any ambiguity in the item? Will the student recognize the purpose of the item? Can it be made more clear? Are there any qualifying phrases that might start the student to thinking along an irrelevant line?
4. Does the item contain any unintentional clues to the correct response?
5. Will authorities agree on the correct response? Are the intended wrong responses less acceptable than the correct one?
6. Are any of the wrong responses likely to appear more plausible than the correct response to the best of the students to be tested? Is the item too difficult for the best students in the group?
7. Is the item phrased as economically as possible? Is it straight forward, direct?
8. Is the form of the item as well adapted as any to its intended purpose? Would a diagram help?
9. Would the rote learner have any undue advantage in responding to the item? Has textbook language been avoided?

In setting up the tests, the following technical problems received consideration:

10. Is the provision for the student's response as economical of his time as possible?
11. Are the directions to the student as simple and understandable as they can be?
12. Does the provision for the student's response provide for convenient, accurate, and economical scoring?

Other technical problems that were considered for each test individually were as follows:

* Pages 139-147.

13. Can the typographical arrangement of the items be improved?

14. Is the spread of estimated difficulty of items adapted to the estimated spread of ability of the group to be tested?

15. Are the time limits adequate?

16. Are the questions placed in the test in an order progressing from easy to difficult, as estimated? Will the slow student be prevented from spending an undue amount of time on items that are too difficult for him?

Each test was checked in view of validity:

17. Are any important objectives or outcomes of instruction seriously neglected in the test as a whole?

18. Is the emphasis on functional value and not on content objectives?

19. Is there any undue testing of isolated detail or unimportant items of information, such as terminology or definitions, for their own sake?

20. Are test situations suggestive of the life situations in which the student may make actual use of what he has learned?

21. Would this test be less satisfactory if used as an "open book" test? Are there a sufficient number of questions which require drawing of inferences and the making of applications?

Obviously these are rigid criteria, and no claim is made that they have been satisfied in every respect. Some have been sacrificed for the sake of others, for example, number 10. The answer sheet requires more of the student's time; it has been estimated that students can answer about ten per cent fewer items when using an answer sheet than when writing directly on the test forms. The students soon became accustomed to using answer sheets in successive testing sessions. Number 10 was sacrificed somewhat, then, for number 12. Convenient, accurate, and economical scoring was essential in this study. Number 5 is another item about which there can be some doubt. It has been impossible in education to secure complete agreement on any complex mental ability. Even in a field as objective as English correctness, you cannot always secure complete agreement as to when it is proper to use a comma and when improper. The questions on rules and other such factual material offer less opportunity for disagreement, which probably partially accounts for the tendency noted among the test constructors of knowledge tests to overweight these items. If we took criteria 5 too seriously and tried to secure 100 per cent agreement from a large number of authorities, we would probably do it at the expense of discrimination. One has only to consult the textbooks in physical education to note the wide variance in opinion of authorities, particularly on performance of skills and on strategy. This variance

of opinion occurs with greater frequency in tennis and in golf, fields in which the professional players tend to dominate the literature. Their mechanical analysis is sometimes faulty.

Selecting the Subjects

All women students majoring in physical education were asked to list the activities in which they had received instruction in high school, in college, in the State University of Iowa, or elsewhere. The records of the activity courses that they had taken here were also checked. The subjects included freshmen, sophomores, juniors, seniors, and graduates. The numbers writing each test were as follows: badminton, 74; basketball, 93; body mechanics, 54; canoeing, 63; field hockey, 82; folk dancing, 75; golf, 63; recreational sports, 87; rhythms, 80; soccer, 48; softball, 69; stunts and tumbling, 69; swimming, 80; tennis, 84; track and field, 52; and volley ball, 86. The tests were given before the season that the activity was taught and again at the end to the group that had just completed the course.

Administration of Tests

The tests were administered to all, except to a few absentees, during regularly scheduled class periods. Each girl was given a page of directions and an answer sheet as she entered the room. A check was made to see that all were supplied with pencils, that no books were brought into the room. After the blanks at the top of the answer sheet had been filled, the test forms were distributed, face down, one copy to each girl. The signal to start writing was given and the time was recorded.

The tests were proctored by one or more members of the teaching staff, and the chairs were six or more feet apart; these factors, combined with the use of an answer sheet, placed the danger of copying at a minimum. No help was given in interpreting the questions.

Records were kept on the order of finishing for the first four girls and the time of finishing, as well as the number and names of those still writing when time was called.

Care was taken to see that each girl received but one copy of the test and that all copies were collected at the end of the period.

DATA AND INTERPRETATIONS

Preparation

The answer sheets for each test were scored by superimposing on them an especially prepared key, with holes punched where the correct answer should appear. A red pencil mark was placed wherever blank spaces appeared through the key, and the total of questions answered correctly was recorded on the answer sheet. The answer sheets were then sorted according to scores and the data were transferred to tabulation sheets.[3] All omissions were treated as errors. For example, the record of a girl with a criterion score of 30 would be recorded in the step interval 30-31, illustrated below

in the portion of the tabulation sheet. If she selected the correct response for question 17, a tally mark was placed in the column headed "R," or *rights*.

R	17	W, O
/	30-31	
	28-29	
	26-27	4
	24-25	
	22-23	0
	(3)	

The record for a girl with a criterion score of *27* would be entered opposite the step interval, *26-27*. If 3 is the correct response and she selected 4, her choice was recorded in the column headed "W, O" or *wrongs, omits*. Note that the correct response is shown in brackets at the bottom of the paper. The record of a person with a criterion score of *22* who omitted the question is also shown in the illustration. The method is described in detail because of its simplicity and usefulness for teachers who wish to check on the effectiveness of their examinations.

The number who succeeded on the question was obtained by adding the tally marks in the column headed "R"; the number failing, by counting each score appearing in the "W, O" column as one.

An item analysis was made to determine the number selecting each response for each question. This was taken directly from the tabulation sheet.

Selection of Items

It was arbitrarily decided to drop any question from further analysis if less than three responses "functioned" in the test. Functioning of an item or response at this stage was defined as being selected by three per cent or more of the total number of persons taking the test (N). If the number of cases was 84 or above, an item had to be selected by at least three persons while if N was 50-83, the minimum was two. The number of questions discarded in this manner varied from one to eleven per test.

The difficulty or percentage of incorrect responses was obtained by dividing the number of errors by N. Thus, a question with a difficulty rating of 40 is less difficult than one with a difficulty rating of 45; the higher the difficulty rating, the more difficult the question. It was arbitrarily decided that few questions would be retained with difficulty ratings below 10 or above 90 per cent, and that preference would be given to those questions with difficulty ratings between 40 and 60 per cent.

"The worth of a test item depends not only upon its desirablity for inclusion in the curriculum and upon its difficulty, but also on its power to discriminate between pupils of high and low levels of general achievement in the field involved."[15] A question is said to be perfect in discriminating power when every student who answers

it successfully ranks higher in the scale than any student who answers it incorrectly. A question may be said to have zero discriminating power when there is no systematic difference between the ability of the students who succeed on it and those who fail. A question in which more students of low ability succeed than students of high ability is said to have minus discriminating power. Between the extremes of perfect and minus discriminating powers, questions of all degrees of discrimination are found.

In large scale test construction, time does not permit the construction of a curve for each question on the basis of preliminary experimentation. "If discriminations are to be made between the items of various degrees of goodness, they must be made on the basis of a single quantitative measure or index of discrimination, that can be conveniently computed and readily tabulated and compared for a large number of items."[25]

Various indices of discrimination have been studied and compared by research workers but no one index is an infallible measure of the validity of an item for all situations, for all groups of students, and for all levels of ability. "The problem of securing a quantitative measure of the validity of a single item has not been satisfactorily solved."[25]

The index selected for this study is the difference between the mean criterion scores of those persons succeeding on the item and of those persons failing on the item, or as expressed in formula form, $M_R - M_W$. This index was recommended by Swineford[5] for a heterogeneous group of subjects and was selected in preference to the other indices for the following reasons:

1. It is easy to calculate.
2. It is based on all the data secured.
3. It was apparently satisfactory when used in the Central Research Committee tests in physical education activities.[43, 44, 45] According to Long and Sandiford,[26] "The better techniques differ so little in effectiveness that ease of computation may usually be accepted as a legitimate consideration in determining which techniques to adopt."

The index was determined for each question in the experimental battery, with the exception of those few questions dropped from further analysis because of having less than three parts "functioning."

The index of discrimination and the difficulty rating were used as guides in deciding which questions to retain. The purpose of the tests was to determine which entering students possess knowledge equivalent to the knowledge of the average student who received instruction in the particular activity at the State University of Iowa. For that reason, questions of around 40 to 60 per cent difficulty were

favored, provided that they had discriminating value. No questions were retained that had minus discriminating power; very few of these appeared in the tests. The size of the index was arbitrarily set at one probable error, but for content reasons, some deviations were made in selecting questions. In two of the tests, one half of a standard deviation was used as the size of the index. An inspection was made of the tabulation of each question to see if the wrong responses were chosen more often by low ability persons than by those in the upper half of the scale. Questions which deviated markedly from this standard were rejected regardless of their index of discrimination or difficulty rating.

The criterion score for each student on each test was the total of right responses. It would have been preferable to validate the tests on the basis of tests known to be valid, constructed for the same purpose, and covering the same content but no such tests were available.

> The use of the total score on a test as a basis for thus evaluating its constituent items is therefore defensible to the degree that the original score provides a valid measure of the ability to be tested. . . . If all of the original items satisfy the subjective requirements for validity, if their content belongs in the subject matter being tested and if they have been well selected and distributed with reference to the objectives of instruction, then the index of discrimination will prove extremely valuable for identifying or drawing attention to those items which are functionally weak because of structural imperfections, ambiguities, inclusion of irrelevant clues, . . .[25]

It is recognized that when the total score on the test itself is used as a criterion that the index of discrimination becomes more a measure of reliability than of validity. However, an index so obtained enables one to select those questions within the tests that are individually most effective in measuring whatever the test as a whole happens to be measuring.

Another factor in selecting the questions to be retained was the time available for testing. Since for the purpose of guidance it is advantageous to do the testing in the short span of time before actual class work starts and since the testing program includes other tests, such as motor ability and various skill tests, the time is quite limited. The time records taken on the experimental battery served as a rough guide in estimating the amount of time needed for the majority to complete the tests. It was decided to attempt to limit the tests to such length that three could be administered each fifty-minute period, which gave an approximate range in material of twenty to twenty-six questions. The entering student rarely has had instruction in all of the sixteen activities; three or four periods will probably be sufficient. The optimum amount of material to administer in a given time limit is obviously that which will yield the maximum validity in that time limit; the data collected in this

study are not sufficient for determining that. It is thought that more material than the optimum would result in a lower validity because of the emphasis on the speed factor, while less than the optimum would result in a lower validity due to the more limited sampling. The determination of the optimum time is a suggestion for further study.

The distribution of content in the short tests approximates the proportions of content in the original tests.

Reliabilities

The reliabilities were computed by the odd-even method and corrected to actual length by the Spearman-Brown prophecy formula. The reliability coefficients for the original full length tests and for the shorter tests are given in Table I. Table I also shows the number of questions in each form of the test and the number of subjects on which the reliability was based.

The reliabilities of the long forms ranged from .702 to .884 which indicates that the criteria was adequate. In most of the tests, the reliability for the shorter form was lower than for the longer form; this is to be expected due to fewer questions, the smaller number of cases, and a narrower range in ability. The reliabilities for the long forms were computed on the total number of cases; for the short forms, they were computed only on those subjects who had had their previous instruction at the State University of Iowa.

TABLE I

Reliability Coefficients for Full-Length Forms and for Short-Length Forms of the Test

	Full-Length Form			Short Form		
	q*	n**	r	q	n	r
1. Badminton	58	74	.856	26	46	.761
2. Basketball	54	93	.854	24	55	.700
3. Body Mechanics	35	54	.702	20	40	.724
4. Canoeing	60	63	.750	26	49	.700
5. Field Hockey	64	82	.865	25	71	.878
6. Folk Dancing	36	75	.733	25	58	.853
7. Golf	60	63	.837	26	47	.794
8. Recreational Sports	63	87	.802	20	55	.710
9. Rhythms	33	80	.871	26	50	.780
10. Soccer	60	48	.823	26	38	.824
11. Softball	55	69	.810	26	33	.634
12. Stunts and Tumbling	35	69	.752	26	49	.619
13. Swimming	65	80	.816	22	55	.843
14. Tennis	60	84	.824	26	59	.826
15. Track and Field	60	52	.780	26	39	.750
16. Volley ball	57	86	.884	26	34	.752

* q refers to total number of questions in the test.
** n refers to total number of subjects in the test.

Mean Scores and Standard Deviations for Full-Length Tests:

Means were computed for all the tests in their full-length form

for two groups: Group A, including all subjects who had had instruction in the activity previous to the first testing and Group B, including the students completing the course at the State University of Iowa during the year 1941-42. Standard deviations were computed for the combined groups for the full-length tests, to give an indication of the range of scores. These data are presented in Table II, which also gives the total number of questions in each test.

Mean Scores for Short Tests

After the questions were selected, all the papers of students who had had their instruction in the activity at the State University of Iowa were rescored, and the papers were separated into two groups: A, instruction at some previous time, and B, those just completing the course. Mean scores were computed for each group as well as for the total number of subjects. These data are presented in Table III, along with the number of subjects and the number of questions.

In both the long and short forms, with a very few exceptions, the "B" group, composed of students completing the courses during the year 1941-1942, was superior to the "A" group, composed of those students receiving instruction prior to 1941-1942. This is an indication that the questions are based upon materials taught in the courses. That the differences are no greater appears to be an indication that the students have retained a considerable portion of the knowledge gained earlier or that the questions are concerned with the information that was important enough to be retained.

TABLE II

Mean Scores and Standard Deviations for Full-Length Tests: Group A, All Who Had Instruction Previous to First Testing; Group B, the Students Completing the Course During the Year 1941-1942

Test	Number of Questions	S. D.	Group A		Group B	
			Mean	n	Mean	n
1. Badminton	58	8.16	27.1	56	31.8	18
2. Basketball	54	8.66	31.3	76	37.7	17
3. Body Mechanics	35	4.70	19.8	43	19.1	11
4. Canoeing	60	7.14	32.0	39	35.4	24
5. Field Hockey	64	8.10	54.0	48	39.6	34
6. Folk Dancing	36	5.86	17.5	57	19.7	18
7. Golf	60	8.08	24.3	48	31.3	15
8. Recreational Sports	63	8.28	28.4	62	35.9	25
9. Rhythms	33	5.92	17.0	57	20.0	23
10. Soccer	60	8.66	31.2	29	37.8	19
11. Softball	55	6.86	25.7	56	29.7	13
12. Stunts and Tumbling	35	4.66	18.9	48	22.3	21
13. Swimming	65	7.70	46.5	63	47.5	17
14. Tennis	60	7.96	35.3	57	40.8	27
15. Track and Field	60	6.86	29.4	31	35.7	21
16. Volley ball	57	8.64	28.6	71	37.4	15

Norms

Norms were established for the short tests on the basis of performance of students who had their instruction at the State University of Iowa. This group included students who had one or more years intervening between instruction and testing as well as those who had just completed the courses, a situation parallel to that of the entering students. The norms are as follows:

Badminton	17	Rhythms	16
Basketball	16	Soccer	14
Body Mechanics	11	Softball	13
Canoeing	15	Stunts and Tumbling	15
Field Hockey	15	Swimming	16
Folk Dancing	12	Tennis	17
Golf	10	Track and Field	14
Recreational Sports	11	Volley ball	17

The number of cases upon which they are based is given in Table III.

Comparison of Tests

Considering the tests in their original full-length form, all had reliabilities above .700; eleven of the sixteen had reliabilities above .800, with five of these eleven exceeding .850. The tests falling below .800 in reliability are as follows: Body Mechanics, .702; Folk Dance, .735; Canoeing, .750; Stunts and Tumbling, .752; and Track and Field, .780. The tests exceeding .850 were Basketball, 854; Badminton, .856; Field Hockey, .865; Rhythms, .871; and Volley Ball, .884.

TABLE III

Mean Scores on Short Tests for All Students Receiving Instruction at State University of Iowa: Group A, All Who Had Instruction Previous to First Testing; Group B, the Students Completing the Course During the Year, 1941-1942

Test	Number of Questions	Group A		Group B		Total	
		Mean	n	Mean	n	Mean	n
1. Badminton	26	16.2	29	18.7	17	17.1	46
2. Basketball	24	15.9	39	17.7	16	16.4	55
3. Body Mechanics	20	11.3	29	10.4	11	11.0	40
4. Canoeing	26	14.2	25	15.5	24	14.9	49
5. Field Hockey	25	12.9	37	16.2	34	14.5	71
6. Folk Dancing	25	12.0	40	12.8	18	12.3	58
7. Golf	26	7.5	32	14.3	15	9.7	47
8. Recreational Sports	20	9.8	31	13.2	24	11.3	55
9. Rhythms	26	15.3	27	16.7	23	16.0	50
10. Soccer	26	13.1	19	15.6	19	14.3	38
11. Softball	26	12.1	21	13.6	12	12.7	33
12. Stunts and Tumbling	26	14.4	28	16.6	21	15.4	49
13. Swimming	22	14.3	38	15.0	17	14.5	55
14. Tennis	26	15.6	32	18.3	27	16.9	59
15. Track and Field	26	10.7	18	15.6	21	13.7	39
16. Volley ball	26	16.3	18	18.4	16	17.3	34

Since the length of tests is known to affect reliability, the number of questions for each test is given below, in alphabetical order:

Badminton	58	Rhythms	33
Basketball	54	Soccer	60
Body Mechanics	35	Softball	54
Canoeing	60	Stunts and Tumbling	35
Field Hockey	64	Swimming	65
Folk Dancing	36	Tennis	60
Golf	60	Track and Field	60
Recreational Sports	63	Volley ball	57

The average number of questions was 53.

Of the five tests falling below .800 in reliability, three had well below the average number of questions; the average for the five tests was 45 questions. Of the five tests with reliabilities above .850, four exceeded the average number of questions; the average for the five tests was 53 questions.

The reliabilities of the short-form tests are of more concern in this study. Ten of the tests have lower reliabilities in their shortened forms than they had in the full-length form; six of the tests have higher reliabilities. The reliabilities vary from .619 to .878, with two falling below .700 and five exceeding .800.

The two tests with reliabilities under .700 are Stunts and Tumbling, .619, and Softball, .634. Both of these tests had higher reliabilities in their complete forms so the addition of a few questions may be advisable.

Other tests in which the reliability was lowered considerably in the short form were Basketball, from .854 to .700; Badminton, from .856 to .761, Recreational Sports, from .802 to .710; Rhythms, .871 to .780; and Volley ball, .884 to .752.

The five tests having the highest inner consistance in the short form are Soccer, .824; Tennis, .826; Swimming .843; Folk Dance, .853; and Field Hockey, .878.

The number of questions discarded because of having too little spread of choices is a rough indication of the amount of nonfunctioning material. No question was retained if it had less than three parts each of which was selected by three per cent or more of the persons taking the test. The total number of questions discarded for this reason was 85, approximately 10 per cent. By tests, in rank order:

Body Mechanics	17.1%	Recreational Sports	9.9%
Swimming	16.9%	Golf	8.3%
Tennis	15.0%	Basketball	7.4%
Canoeing	13.3%	Soccer	6.7%
Track and Field	11.7%	Field Hockey	6.3%
Stunts and Tumbling	11.4%	Rhythms	6.1%
Softball	11.1%	Folk Dancing	5.4%
Volley ball	10.5%	Badminton	1.7%

The only groups of tests in the literature with which compari-

sons of results can be made are those reported by Snell [47, 48, 49] and by Scott.[43, 44, 45] Snell gave tests in seven of the activities included in this study: basketball, field hockey, golf, soccer, softball, tennis, and volleyball. Her tests consisted of seventy multiple choice questions in each activity; she eliminated until 45 questions remained. The reliabilities for the 45-question forms are shown in the following:

	Snell (45)	This Study Short Form	This Study Long Form
Basketball	.669	.700 (24 q.)	.854 (54 q.)
Field Hockey	.927	.878 (25 q.)	.865 (64 q.)
Golf	.702	.794 (26 q.)	.837 (60 q.)
Soccer	.857	.824 (26 q.)	.823 (60 q.)
Softball	.856	.654 (26 q.)	.810 (54 q.)
Tennis	.655	.826 (26 q.)	.824 (60 q.)
Volley ball	.846	.752 (26 q.)	.884 (57 q.)

Comparing her reliabilities for 45 questions to the tests in the short form in this study, four were higher and three lower. The full-length tests in this study more closely approximate hers in length but are at a disadvantage in not having had the poorer questions "weeded out." Nevertheless, four out of the seven have higher reliabilities than those obtained in the Snell study.

The Research Committee of the Central Association of Physical Education for College Women (Scott) has published tests in three of the activities included in this study. In swimming and in tennis, two tests were published, one for elementary and one for intermediate tests. The questions were of two types: multiple choice and true-false, as indicated in the comparative chart presented below:

	Scott	This Study Short Form	This Study Long Form
Badminton	.790 (47 M. C. q.)	.761 (26 M. C. q.)	.856 (58 M. C. q.)
Swimming	.867 (22 M. C. q.) 36 T. F. q.)	.843 (22 M. C. q.)	.816 (65 M. C. q.)
Tennis	.780 (21 M. C. q.) (30 T. F. q.)	.826 (26 M. C. q.)	.824 (60 M. C. q.)

A comparison of the validities is possible only by examining the questions themselves in relation to the purpose for which they are intended. Both the Scott and Snell sets of tests were constructed for students in general college classes.

Suggestions for Use

The sixteen tests constructed in this study appear adequate for the following uses:

1. As partial determiners of the technique requirements at the State University of Iowa.
2. As a basis for profile charts, indicating areas of strength and weakness for the individual student.
3. As a basis for scheduling technique classes according to student needs and for arranging each student's schedule in advance so that all requirements can be fulfilled in major classes.

4. As an indication of the student's ability to retain information and to make applications.

5. As an indication of the student's ability to profit by instruction, when the tests are given preliminary to instruction and after instruction.

Because tests are frequently misused, it is considered worth while to include the warning that an item does not possess a certain validity *per se;* its value has specific reference to the group tested or to groups where the criterion ability is very similarly distributed. If the test is to be used in other situations or for other purposes than those defined in this study, the content distribution should be consulted.

CONCLUSIONS

In the sixteen activities included in this study, the tests constructed appear adequate for determining which entering students possess knowledge equivalent to that possessed by students who have had their instruction at the State University of Iowa.

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Further Data on the Pulse-Ratio Test

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THE increasing emphasis on physical fitness has caused many physical educators to feel the need for an adequate measure of this condition. Such a measure could be used before and after a specified period of activity to evaluate the effectiveness of the program, or it could be used for the classification of individuals.

The high correlation obtained by Rifenberick[1] between Roger's Test of Physical Fitness and the Pulse-Ratio Test, led the investigators to hope that the Pulse-Ratio Test might be the answer to this need for a simplified measure of physical fitness.

Therefore, this investigation was undertaken to determine, with college women as the subjects (1) The objectivity of the Pulse-Ratio Test when given by inexperienced persons, using the palpation method; (2) The reliability of the Pulse-Ratio Test; (3) The validity of the Pulse-Ratio Test, provided the reliability were sufficiently high to justify its use.

PROCEDURE

The subjects in this study were college women, selected at random from the regular physical education classes. Their ages ranged from 17 to 23 years, with the average age 18.9. Tuttle's[2] technique of administration was carefully followed, using 30 stool steps per minute for the exercise. In computing the pulse-ratios, Tuttle's[3] simplified method was used, in which the total pulse rate for two minutes following the standard exercise, is divided by the normal resting pulse for one minute.

Pulse rates were secured by the palpation method, using the carotid pulse at the neck. In order to determine the objectivity of this method, two operators worked simultaneously on each subject, one taking rates at the right carotid, the other at the left carotid. The rates secured by the two operators were recorded independently through a third person. Resting rates were taken until three successive rates, with a minute's interval between each, showed a

[1] R. H. Riefenberick, "A Comparison of Physical Fitness Ratings as Determined by the Pulse-Ratio Tests and Rogers' Test of Physical Fitness," *Research Quarterly*, (Mar., 1942) 95-101.

[2] W. W. Tuttle, "The Use of the Pulse-Ratio Test for Rating Physical Efficiency," *Research Quarterly*, 2 (May, 1931).

[3] W. W. Tuttle, and R. E. Dickinson, "A Simplification of the Pulse-Ratio Technique for Rating Physical Efficiency and Present Condition," *Research Quarterly*, 9 (May, 1938) 73-80.

variation of not more than a beat or two. The reading of all resting rates was preceded by a minimum rest of five minutes.

Three operators were concerned in determining objectivity, M. P., E. R., and H. Y. Two sets of objectivity comparisons were secured, one between M. P. and E. R., and one between M. P. and H. Y. All three operators were inexperienced in taking heart rates.

In order to determine the reliability, the test was given twice to each subject. Both trials were given the same day, with a minimum of forty minutes and a maximum of seventy minutes between the two trials. All tests were taken between two and five o'clock in the afternoon.

RESULTS

TABLE I

OBJECTIVITY CORRELATIONS

Operators	M. P.		E. R.		M. P.	H. Y.
	No. of Cases	Correlation	Probable Error	No. of Cases	Correlation	Probable Error
Resting rates	105	.999	± .0001	99	.996	± .0005
After exercise	105	.995	± .0005	97	.992	± .0010
Pulse-ratio	105	.979	± .0027	97	.985	± .0020

The figures shown in Table I indicate that there is an extremely high degree of correlation between the scores of the different operators, in all measures concerned. The palpation method of securing heart rates has been subject to considerable criticism; however, the objectivity correlations secured in this study would indicate that the method used was quite a good one. It has usually been customary when using the palpation method, to secure pulse readings at the radial pulse on the wrist. By using the carotid pulse at the neck, it is possible to count the very first beats after exercise without any difficulty, as after exercise, the pulse is very prominent all over the neck area and can be felt by a light touch of the finger. Subjects were questioned concerning any possible feeling of discomfort from this method, but none reported she experienced any unfavorable reaction. The resting rates, too, were much easier to secure at the carotid pulse, due to a more prominent beat. The greatest source of error in counting the rates after exercise occurred when an operator occasionally lost count and either added or lost ten beats. This could easily be corrected by some mechanical method of recording, such as marking with a pencil every ten beats counted.

TABLE II

RELIABILITY CORRELATIONS

	Number of Cases	Correlation	Probable error
Resting rates	96	.856	± .018
After exercise	96	.849	± .019
Pulse-ratio	96	.774	± .027

The reliability correlation of .774 for the pulse-ratio test is not sufficiently high to make the test valuable for use with individuals,

although it could be used for group comparisons. This correlation supports the one of .78 found by Henry and Farmer.[4] The resting heart and rates taken after exercise have a fairly high degree of reliability as indicated by the correlations of .856 and .849 respectively.

In the course of administering the test, it was noticed frequently that the individual whose normal resting rate was low had a comparatively higher after-exercise rate than the individual whose normal resting rate was high. If this were consistently true, it would indicate that individuals with high resting rates would tend to have a low pulse-ratio and vice versa. An examination of the figures reveals that the girl with the lowest pulse-ratio, 2.104, has a resting heart rate of 85; while the girl with the highest pulse-ratio, 3.569, had a resting rate of 65. The lowest resting heart-rate recorded is 61, this girl having a pulse-ratio of 3.049; while the highest heart-rate recorded is 109, and the pulse-ratio of this girl is 2.623.

On the basis of this evidence, the investigators divided the cases into two groups. One group contained all cases in which the resting heart was above the mean resting rate of 82.1, and the other group contained all cases in which the resting rate was below the mean. Subjects whose resting rates were 82 were omitted. Average pulse-ratios were figured for each of these two groups.

TABLE III

	No. of Cases	Average Pulse Ratio	σm	Range	S. D.
Group with resting rates above the mean	99	2.704	.025	2.104 3.373	.258
Group with resting rates below the mean	81	2.844	.028	2.346 3.359	.259

Table III gives the data for the two groups. The difference between the average pulse-ratios of the two groups is .140; that this is a significant difference is shown by a critical ratio of 3.62.

In order to further substantiate the existence of this relationship, the average pulse-ratios were found for resting rates at intervals of ten beats. Reference to Table IV, indicates the very definite tendency of people with low resting rates to have high pulse ratios and vice versa.

TABLE IV

Resting Rate	Number of Cases	Average Pulse-ratio	Range	S. D.
60-69	17	3.004	2.565-3.569	.223
70-79	66	2.836	2.339-3.506	.271
80-89	73	2.737	2.104-3.373	.272
90-99	33	2.690	2.281-3.086	.215
100-109	8	2.603	2.349-2.826	.155

[4] Franklin Henry, and Daniel Farmer, "Functional Tests II: The Reliability of the Pulse-Ratio Test," *Research Quarterly*, 9 (May, 1938) 81-87.

In view of these figures, the evidence would seem to indicate that the pulse ratio is determined less by the physical efficiency of an individual than by the size of his resting heart rate.

Information was secured from each subject concerning her smoking habits. A comparison between the heart rates and pulse ratios of smokers and non-smokers is given in Table V.

TABLE V

	No. of Cases	Resting Rate	Two min. after Exercise	Pulse Ratio
Smokers	26	82.7	228.3	2.760
Non-smokers	59	82.2	229.2	2.788

The average number of cigarettes smoked per day by the smokers is ten cigarettes. Girls who smoked occasionally or only a few a day were omitted from both groups. Obviously, the very slight differences between the two groups are not significant. This cannot, however, be considered as conclusive evidence on the effects of smoking.

It would probably be advisable in a future study to limit the term "smoker" to individuals who smoked at least twenty cigarettes a day. It is quite possible, also, that the college women used in this study on smoking, whose average age is 18.6, had not been smoking a sufficient length of time to produce any noticeable effect.

SUMMARY

The investigators were hopeful of proving the Pulse-Ratio Test a good measure of physical efficiency for use with college women. In order to determine the goodness of the test itself, objectivity and reliability correlations were figured. The palpation method of securing heart rates was used, with the pulse being taken at the carotid artery.

A comparison was made between the average pulse-ratios of two groups. In the first group are all cases in which the resting heart rate is below the mean resting rate of 82.1; the second group contains all cases in which the resting heart rate is above the mean rate.

A comparison of heart rates and pulse-ratios was made between a group of smokers and non-smokers.

CONCLUSIONS

1. The objectivity correlations are sufficiently high to justify the use of the palpation method of securing heart rates at the carotid pulse.

2. The reliability correlation of .774 for the Pulse-Ratio Test is too low to make the test valuable for individual measurement, although it could be used for group comparisons.

3. There is a definite tendency for individuals with low resting

heart rates to have a high pulse ratio and those with high resting heart rates to have a low pulse-ratio. This tendency is not limited to extreme cases but shows a decided trend in this direction at all levels of resting rates.

4. The reliability correlation is too low to justify the expenditure of time needed to validate the test for college women.

5. There is no significant difference between the resting heart rates, after exercise rates and pulse-ratios of the two groups, smokers and non-smokers, used in this study.

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